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The Boiler Room.

It is gratifying to observe that a subject which has received frequent mention in this journal is now attracting attention in several countries. This is the possibility of securing important economies in the cost of power by giving more attention to the design and operation of the boiler plant. The engineering journals of Great Britain, Germany and France have lately contained interesting discussions of this subject, and in all cases these discussions have been along the same lines. The advocates of boiler room reform have claimed that a considerable sum might be saved annually by putting in a proper plant in the first place and paying enough to run it properly in the second place. The opponents of reform have claimed that in most industries the cost of power is such a small proportional part of the total expense of the manufacturing process that a saving in it of possibly 50 per cent. will have an infinitesimal effect on the total cost of production.

Taking up first this thread-bare objection, which is about all that can be said against improving boiler room practice, it may be acknowledged that in many industries the cost of producing steam is a very small percentage of the cost of manufacturing. Nothing more will be granted, however; the inference that because the saving is a very small percentage of the total cost of conducting an establishment it is not worth considering, is not admitted for a minute. If there is any one habit of thought which is pernicious in its general results it is this one of using percentages. In the hands of an intelligent man they are of assistance, but in such a matter as the introduction of reform in the boiler room they are as out of place as considerations of Greek roots in the determination of the strength of a column. If by spending $2,000 it is possible to save $4,000, it is difficult to see what is the use of putting that $4,000 into a percentage, where it is lost to sight. It is, of course, a little insignificant matter in the annual expense account of a great corporation, but it is not so trivial when the average man looks on it as a possible addition to his income. If it can be saved in the expense account of a great company this should be done, for it is only by the exercise of care in keeping down all these small wastes, each the fraction of one per cent. of the whole operating charges, that a corporation can hope to increase in prosperity as it increases in size.

Assuming that economy in the boiler room is worth attaining, even though its percentage value is not high in the annual summary of expenses, the methods of securing this economy are to be considered, and here it is gratifying to observe that the older views are being modified. The greatest source of waste is in careless firing. The introduction of good mechanical stokers has unquestionably effected an economy of fuel in many plants, although in some stations where firing is not regarded as unworthy of careful attention, the man keeps up with the machine. The figures given out last year by the Boston Elevated Railway Co. show that in conscientious New England hand stoking is by no means a lost art, and that it is just as satisfactory when well done as mechanical stoking. The trouble is that it is rarely well done. It was held some time ago that the remedy for this state of affairs was to be found in the education of the firemen. This does not mean that an instructor is to be sent down from the nearest technical school several times a week to talk over the knotty points of thermodynamics with the men, but rather that the firemen are to be shown the leading effects of different methods of stoking. This plan would be all right if it was not for the fact that the average man who acts as stoker in a boiler room does not care a whoop about anything except satisfying the boss with as little work as possible. This fact has begun to dawn upon those who are looking about for a method of increasing the efficiency of boiler room operations, and as a result they have reached what seems to be a very self-evident conclusion.

Economy in the boiler room, we are now told by recent discussers of the subject in several countries, can be best secured by having a chief engineer who knows his business, aided, in the case of large plants, by a chemist who can keep in close touch with a number of features of operation. This solution of the matter is directly in line with the evident tendency of manufacturing in many lines to have a thoroughly competent man at the head of each department and make him responsible for administering its affairs with the maximum economy. In the case of a boiler plant, it makes him responsible for keeping the furnaces in good condition, watching the quality of the coal, and seeing that the firing is so conducted that the cost of steam is as low as possible. In the present advanced condition of knowledge regarding steam plants it is manifest that such a man is a valuable assistant and will demand a good salary. It is difficult to see how much economy can be attained in the boiler room of a large plant without some such man in charge, and it is for this reason that there is an international consensus of opinion that the first step in securing economy is to engage such a man and give him plenty of authority.

The Importance of Temporary Work.

A few days ago one of the leading engineers of the country returned to this journal a description of important work executed under his direction, with a blue pencil mark through one of the most interesting portions. It described some temporary work, and the engineer's desire to have it omitted was evidently because it was not of a permanent character; in fact, his views were stated to be of this nature in the following note: "This work is a mere make-shift, and, in fact, if I was to criticise my own work, I would jump on this about the first thing, for not having tried harder to have this hole taken care if in a permanent way. As an economic proposition, however, it is all right, for the cost of the temporary work, plus the filling afterward, costs less than the attempt to fill it at present." If the temporary work is all right economically, then it certainly deserves a place in a description of the entire undertaking, and for this reason The Engineering Record hopes to be able to explain it at the proper time. The object in calling attention to the matter now is to express a protest against the habit of some very good engineers of refusing to allow such temporary work to be made public. The purpose of engineering is to accomplish a desired result in the most economical manner, and if that result is best attained by temporary structures which will be later replaced by permanent works it is manifestly desirable to say so.

As a matter of fact, it is coming to be recognized that some of the most creditable work done by the engineer is that which tides over difficulties until his clients are in a position to put a larger sum into structures than is warranted during the first days of the enterprise. A large measure of responsibility is not carried where funds are plentiful and the services of specialists can be called upon whenever a knotty problem comes up. The results of work done in this way are monumental and can be described in very interesting papers before engineering societies; but they are really not so interesting as some others to the engineer who believes that the best work of his profession is still done in pioneer enterprises. These call for technical knowledge of the highest character, practical acquaintance with all grades of temporary construction and the ability to foresee future developments so accurately that a nice balance can be struck between the cost of different designs and the most economical works for future as well as present conditions. The temporary structures often called for on such enterprises are not particularly interesting in themselves; in fact, a description of them in a technical journal would be unwarranted unless it was accompanied by an explanation of the reasons for their use. Nevertheless a proper explanation of such work is a contribution to engineering information of the highest value, for it makes clear the reasons for methods and for designs not described in textbooks but just as important as those for permanent works.

It is a frequent observation of this journal that engineers dislike to have anything said concerning structures not built according to the latest rules. They seem to feel that such works reflect discredit on them and indicate a lack of knowledge on their part of what is the best practice. As a matter of fact, the manner of meeting difficult problems presented to the engineer by parties having but little money to spend on their solution is one of the most interesting fields for descriptive articles. No engineer who has not had to solve such a problem can appreciate the satisfaction which comes from finally discovering a solution within the resources of the parties interested; in such work the usual methods of the textbooks have to be modified, and the judgment of the designer is well shown by the result. It is judgment rather than technical information which is the best quality of a great engineer in these days, and for this reason it is safe to say that a large amount of temporary construction, which has never been described in technical journals or the proceedings of engineering societies, is really a better proof of engineering ability than some of the great works which are spoken of as triumphs of the profession.

The correctness of these views is indicated by the tendency on some of the most important and wealthy railways of the country to employ designs which are essentially lacking in some of the features of permanence. There is no question about the ability of these companies to pay for any class of work they wish to obtain, and yet they prefer to put in rather inexpensive structures until they are absolutely sure of what the future requirements will be. The work of this class is willingly given out for publication, yet the still more temporary structures for a service of five to ten years, which are justified by precisely the same considerations, are kept hidden so far as possible. This is a poor policy, for it keeps from the younger men entering engineering, a class of information which they should acquire as thoroughly and promptly as possible.

Materials for Earth Dams.

A short time ago a senior in one of our engineering colleges sent a request to this journal for a list of papers in which he could find a discussion of the availability of different materials for reservoir embankments. This would be a pretty stiff request to comply with had not such a list been temporarily available. With the owner's permission it was copied and sent to the inquirer, with a feeling that the correspondence would not end at that point. It did not. The student read the articles referred to with evident care and equally evident bewilderment. He noted, as every other examiner of "authorities" on the subject has noted, the direct conflict of opinion of equally eminent engineers concerning most of the materials employed for earth dams, and has accordingly decided that the subject is a little too complicated for him to settle in a graduating thesis. This is an indication of sound judgment which deserves approval. As a matter of fact, the time has come when all "authorities" can be safely abandoned. Fortunately, America now has enough good precedents for the use of various materials in such structures to allow the engineer a wide latitude in the selection of the gravel, clay, earth and other possibilities for a given structure.

The change in the feeling on this subject probably became most marked when Mr. F. P. Stearns built the great dikes of the Wachusett reservoir near Clinton, Mass. In these he used a material rarely employed before, but he used it in a way which leaves an opportunity for no unfavorable criticism. In other words, he has designed the structures for the materials of which they are built, and has not hunted about for materials suitable for works of the customary cross-section. It is not at all unlikely that this practice will come into more frequent use, for it is probable that broad dikes will sometimes prove more economical to construct than dams of smaller cross-section requiring materials which can only be secured at considerable expense.

As a matter of fact, dams are now standing which offer safe precedent for the use of most classes of earth and gravel. They are answering their purpose satisfactorily, because they are so constructed that the properties of these materials are utilized in a proper way. The trouble with unsatisfactory dams of such materials has generally been that their designers have not varied the cross-sections to correspond with the different materials used, but have attempted to retain the same general cross-section with each of them. Hence, instead of employing each material in masses sufficiently thick to withstand the percolation of water, the attempt was made to retain the slopes and thicknesses which experience has shown to be best with puddled gravel and clay only. In India this traditional section was abandoned many years ago, and even sand has been used in that country for dams of considerable height. Care has been taken there to prevent the percolation of water below the base of such unusual structures and to provide a good core wall, but for the great mass of the embankments reliance has been placed more on thickness and thorough consolidation than on the selection of materials which conformed with accepted canons of engineering.

In the last two or three years Professor Ries, Dr. Allerton S. Cushman, and a few other investigators have been studying the properties of clay and other materials which enter into the construction of dams, and their researches explain why one engineer has refused to use clay in dams while another insists on it. Without going into this subject, it might be stated in a very general way that earth, loam, clay and similar names have no scientific meaning, and two materials, both ordinarily classified as clay, may be so unlike in their availability for use in a dam that they require radically different treatment. Hence it is not surprising that one engineer has found clay unsatisfactory while another has had a contrary experience, when it is reflected that the attempts to use this material have been made along the same lines, without regard to the fact that clays differ very greatly among themselves. In the same way it may be pointed out that what is called loam may vary very greatly in its properties. This has been noticed in connection with tests of the effect of loam in sand used for mortar, and if any grade of loam enters into the construction of dikes it is necessary to ascertain its properties before determining the way in which it can be used.

Summing the matter up, it may be said that the practice is gaining favor of determining first the character of materials available for an earth dam and then designing the structure so as to employ these materials, rather than adopting a so-called standard cross-section and then scouring the country for material to put in it. More attention is being paid to providing ample spillways than to keeping the width of a dam down to the least possible thickness, and greater care is taken to secure impermeable foundations than to obtain the slopes which were thought necessary for a good-looking dam twenty-five years ago.

Test of a Refuse Destructor at Nelson, England.

A test of a refuse destructor which included continuous sampling of the gases of combustion looking toward an analysis of the refuse itself was made in 1903 on a Meldrum destructor at Nelson, England, by Mr. C. E. Stromeyer, chief engineer of the Manchester Steam-Users' Association. It has one continuous grate 20x5 ft. in a furnace chamber 22x6 ft., with four separated ash pits. The ash pits are supplied with hot air under pressure by steam-jet blowers which force the air for combustion through a regenerator; this is placed in the path of the combustion gases and is designed to heat the air to about 350° Fahr. An average evaporation of steam from the steam boiler of the plant of 1.788 lb., from and at 212°, including steam jets, was obtained per pound of refuse. The composition of the fuel as calculated averaged as follows: Carbon, 31.4 per cent., including an average of 4.9 per cent. found in the ashes; moisture, 32.7 per cent.; mineral matter, 35.3 per cent. Its average estimated calorific value was 4,442 B.t.u. per pound.

From a balance of the heat expenditure, it appeared that the average heat utilized in the production of steam, exclusive of that used by the blowers, amounted to 36 per cent., which Mr. Stromeyer considered a high duty, when it is remembered that the carbon and the heat in the ashes accounted for a loss of 20 per cent. With ordinary fuel containing only a few per cent. of mineral matter this loss, he said, would have been only about 2 to 3 per cent., and then the efficiency would have been 45 per cent. The heat carried up the chimney amounted to an average of 19.3 per cent. The tests were held on two succeeding days, and the results are in some instances somewhat different in value, but the figures given are the average of the two sets.

There was a considerable difference in the heat balance between the estimated radiation on the two days. It amounted to 9.4 per cent. on one and 30.6 per cent. on the other, with a mean rediation of 20 per cent. The estimated flame temperature was higher on the second day, and the increased radiation might, the author ventured, account for part of the difference. He outlined briefly, however, sources of errors in observation, such as the determination of the weight of the steam used in the blowers, of the amount of the fine dust in the destructor flue or of the quantity of moisture in the flue gases, all of which materially affect the gas analysis and the deductions drawn therefrom in a searching inquiry such as that conducted by the author.

Attention is drawn to this test at this late date both because the results have only recently been printed and because they suggest the importance of expert advice in problems involving combined boilers and incinerators.

Notes and Comments.

A Refuse-Destructor-Steam-Turbine Plant, erected by Messrs. Brown, Boveri & Co., in the outskirts of Zurich, is employed to supplement the town electrical supply, according to "Elektrotechnische Zeitschrift." There are 12 destructor cells of the Horsfall type, supplied with forced draft by an electric fan and with means for heating the air by passing it around the furnaces before combustion. The gases are led through two water-tube boilers, which supply steam at 115 lb. pressure and 480° Fahr. temperature to a 150-kw. Parsons turbine generating unit.

Public Electric Service supplied from gas engine units receiving town gas is the interesting condition at Leek, England, where, according to the "Electrical Review," of London, two Stockport horizontal 100-h.p. engines are in use, coupled to 60-kw. dynamos. A 300-ampere-hour storage battery is employed in connection with the generating sets, and the town is supplied by two feeders, 2,820 and 1,110 ft. long, respectively, and by 6,900 ft. of distribution circuits.

The Decimal Association of Great Britain reported at its annual meeting in January that its bill for the compulsory adoption of metric weights and measures had passed the House of Lords and been sent to the House of Commons, where over 330 votes in its favor have been pledged already. Every effort will be made to carry the bill through the Commons this year and there is a prospect of the early success of the measure. The report states that "the movement has the support of a large majority of the most eminent men and leading firms in the country." Copies of the report, which indicates an advanced condition of the metric agitation somewhat surprising to Americans who have not followed its steady progress in Great Britain, can be obtained from the secretary, Mr. Edward Johnson, Oxford Court, Cannon St., London.

The Coal Supply of Great Britain has been the subject of many prophecies, both gloomy and cheerful, and for this reason it is interesting to note that a Royal Commission has recently submitted an optimistic report. It states that there are about 81,529,000,000 tons in Great Britain and 155,000,000 tons in Ireland within a distance of 4,000 ft. of the surface. This depth is about the present limit of practicable working, and the estimates show that down to this limit there is enough fuel for four centuries. The Commission believes that the introduction of improved appliances and methods of working should reduce the large amount of waste that now occurs.

The Advantages of Superheating or Steam Jacketing as applied to steam turbines was discussed recently in the "Engineering Review" of London, by Mr. A. H. Gibson. He concluded that the combination of slight initial superheating and steam jacketing offers the best solution and almost ideal conditions, especially for turbines of the single-chamber Parsons type. In the case of the one-stage de Laval type high initial superheat seems to be the most suitable method, and with those of the multiple-stage—Curtis, Riedler-Stumpf, or Westinghouse-Parsons type—initial superheating to a moderately high degree, with reheating between the stages of expansion, is preferable.

The Performance of a Steam Engine with separate piston valves for admission and exhaust, installed in the central electric station at Mülhausen, Germany, has been referred to recently in European technical journals. The valves are of the Frikart type of horizontal piston valves, two for admission and two for exhaust, to avoid condensation caused by employing a single piston valve at each end of the cylinder. The consumption of steam is given as 10.69 lb. per indicated horse-power per hour, and 16.5 lb. per kilowatt-hour at a load of 635 kw. The engine has 23.6-in. and 43.3-in. cylinders, with a 51.2-in. stroke. The speed is 94 r.p.m.; the steam pressure 150 to 170 lb., and the superheat at the high-pressure cylinder, 525° to 575° Fahr.

Experimental Engineering Work with the assistance of State funds is proposed at the University of Illinois. The State has been very generous to the Agricultural College of late years, especially in the matter of providing funds for carrying on research work, and the results obtained by the Agricultural Experiment Station are proving of great value to the agricultural interests of Illinois. It is felt that the engineering and industrial interests are deserving of the same treatment, and that appropriations for research work and the study of problems of importance to engineering, manufacturing, building and industrial interests would be productive of correspondingly large returns. Manufacturing in Illinois is increasing rapidly, and her natural resources have just begun to be developed. At the present time there are many problms which are important in many cities, which can be best solved by the investigations of well-equipped, well-managed laboratories like those of this university. The proposition deserves generous support.

The Reisert Case seems likely to become one of those legal matters with which the waterworks designer must be as familiar as with principles of hydraulics. It involves the right of a city to operate a driven-well plant which influences the value of cultivated ground by drying up a small surface stream. The case is now in its second stage. In the first stage it was settled by decisions reviewed in these columns that the city was responsible for damages, and the present litigation is to fix the method of determining these damages. The latest decision is printed in full elsewhere in this issue. Few cases have attracted more attention from civil engineers than this, for it affords weighty legal precedents. Although the principles fixed by the New York courts may not be adopted in any other State, nevertheless the learning of the New York judges has such a high rating throughout the country that their decisions are always of much importance in determining the trend of opinion.

The Trials of a Pumping Engine with telescopic plungers were reported by Mr. Edmund Morris in discussing a recent paper by Mr. John Barr, of Kilmarnock, Scotland, before the Institution of Mechanical Engineers on waterworks pumping engines in the United States and Canada. The engine is located in the Hornsey station, London, and is of the triple-expansion type with 21-in., 34-in., and 52-in. steam cylinders, and 4-ft. stroke pumps arranged to serve two reservoirs at different levels, so that each plunger is divided in two, one plunger working telescopically within the other. The larger is 27 in. in diameter, and when pumping against 113.8 ft. head, developed a pump horsepower of 257 h.p. on a mechanical efficiency of 87 per cent., used 11.6 lb. of dry steam at 155 lb. pressure per indicated-horse-power per hour, and exhibited a duty of 148,800,000 ft.-lb. per 1,000 lb. dry steam. The smaller plunger was 18½ in. in diameter, and when pumping against 267.7 ft. head, developed 287 pump horse-power on a mechanical efficiency of 88 per cent., used 11.5 lb. of dry steam at 155 lb. pressure per indicated horse-power per hour, and exhibited a duty of 152,300,000 ft.-lb. per 1,000 lb. of dry steam.

Crematories with Steam Plants worked in connection with them are the subject of a decidedly sensible letter in "Engineering" from Mr. F. L. Watson, of the Horsfall Destructor Co. He points out that the amount of current produced per ton of refuse burnt depends chiefly on five factors: 1, The calorific value of the refuse. 2, The conditions as to the day and night load, which determine whether all the refuse is used for steam raising or whether the destructor is working at full power while the electricity plant is practically idle. 3, The efficiency of the electrical generating plant, which may require more or less steam per unit generated. 4, The efficiency of the destructor plant, with its boilers and flues. 5, The efficiency of the management. Where there are so many important factors to be considered it is absurd, Mr. Watson states, to attribute to the destructor the whole credit for good results or the whole blame for a poor showing. A most important item of expense in plants having a high efficiency is the labor charges. These charges may be carried so high in an endeavor to produce a large amount of current from the burning refuse that the final cost of the steam and fuel economies is unjustifiable.

Service Tests of Paint have received the attention of a committee of the American Society for Testing Materials for a considerable time, and at the Society's last convention this committee presented a report embodying the very divergent views of its members. Since that convention, the committee has reached the conclusion "that standard methods of making service tests should be formulated and adopted in order that laboratory tests may become of real value in determining the efficiency of protective coatings." Sub-committees have been appointed to investigate certain subjects; these sub-committees and their chairmen are the following: Standardization of Service Tests, G. W. Thompson; Tests to Determine Permeability of Films, Dr. C. B. Dudley; Preparation of Surfaces before Painting, J. W. Whitehead, Jr.; Investigation of Field Tests, W. A. Polk; Permanence of Paint Films, Malcolm McNaughten. It is felt that this concentration of effort will hasten the solution of some of the problems under investigation, and although a final report cannot be expected for some years, still each year's work will add to the sum of knowledge on the subject. The chairman of the committee is Mr. S. S. Voorhees, of the Treasury Department, Washington.

The Pintsch Light, used in a large proportion of the most important passenger trains in Europe as well as the United States, is now being improved by the use of an incandescent mantle. The compressed oil gas used in this system gives a light of about 8 c.p. per foot per hour, while with the mantles used on a British train 25 to 30 c.p. is obtained from 0.6 cu. ft. According to "Engineering," a Brighton & South Coast train fitted with these mantles is most brilliantly lighted, and the illumination is far better than on the best-lighted trains with ordinary Pintsch burners. The main difficulty in using incandescent mantles has been their short life, due to the jarring of the car. The tougher mantles recently introduced have an average life of two months, and have a wire cage below them which catches and retains their fragments. These pieces are still played on by the flame and give a fair light, so that the failure of a mantle does not entirely extinguish its light. If this system is as successful as reported, it ought to be introduced into the United States right away. One of the most unsatisfactory features of traveling is the poor light in the cars, which makes reading a severe strain on the eyes, and it is gratifying to learn that the engineers of the English Pintsch company have made such an important improvement.

THE RAPID CONSTRUCTION OF THE BALTIMORE-AMERICAN BUILDING.

The building occupied by the Baltimore-American daily newspaper, Baltimore, Md., was destroyed in the great fire of Feb. 7, 1904, and although it was several months before questions regarding the site and the general plan of reconstruction and street alignment in that district were settled so that the new buildings could be confidently commenced, yet a tall and handsome new structure has been built during the summer and fall and finished in time to be occupied on the first anniversary of the destruction of the old one. The new building, on the old site has maximum dimensions of about 65x 117 ft., and has fourteen stories and a basement with a total height of about 180 ft. above the curb. It is of fireproof steel cage office construction, containing about 1,500 tons of structural steel, and was built by the George A. Fuller Co., N. Y., for a contract price of about $500,000. The walls on the two street fronts and one side are of Indiana limestone masonry, and on the rear and light court are of light colored brick with terra cotta trimmings. The floors and roof are hollow tile, flat arches covered with cinder concrete; the partitions are of 4-in. tiles and the columns and girders are enclosed by hollow tiles and brickwork, so that no portions of the steelwork are exposed.

Foundation Work, June 17.

Setting Columns, Aug. 15.

Operations were commenced about May 1, 1904, and the debris was loaded by hand into 1-yd. steel reversing buckets and rectangular skips handled by a 15-ton guyed derrick seated on a 20-ft. wooden tower and operated by a two-drum Mundy hoisting engine which with its boiler was permanently located in the street close to the curb. The derrick had a 40-ft. mast and a 50-ft. boom and was located to command the whole site and discharge the contents of the buckets and skips on an inclined platform elevated about 10 ft. above the street so that wagons could drive under and be quickly loaded direct from the buckets or from materials previously dumped on the chute. The old cellar floor, about 15 ft. below the curb was removed and the general excavation was carried from 6 to 8 ft. deeper. Some water was encountered, but was removed with steam and hand pumps and pulsometers and concrete piers were built up and grillage beams set on them to receive the cast-iron column bases with their upper faces about at the level of the cellar floor.

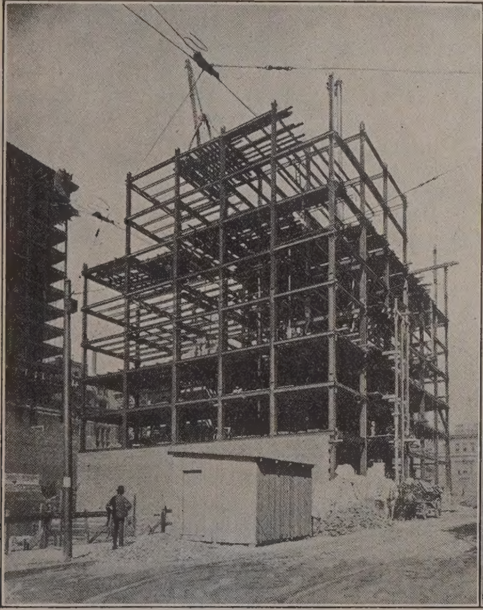
Plank platforms were laid on the ground and on them sand, stone and cement were stored and concrete was hand-mixed adjacent to the piers where it was used. The lower parts of the old exterior walls were found to be in good condition and were underpinned and left in place, brickwork and masonry being started on the sound portions while the column pits were being excavated. The sidewalk vault retaining walls were left standing, but were faced with 8 in. of new brickwork and the premanent steel sidewalk beams were set on them and supported with temporary wooden shores under their inner ends with scab planks nailed to the sides to prevent the beams from being displaced. A platform was laid on these beams, and as there was little ordinary business in the street to require sidewalk accommodation, it was utilized for the unloading and storage of materials, and for the location of hoisting engines, contractor's office, etc.

On August 1, all of the excavation and foundation and retaining walls had been completed, most of the piers built and the setting of the grillage beams had been commenced. On August 15 many of the cast iron column bases had been set on the grillages and some of the lower sections of the columns had been erected and were braced, until secured by the first tier of beams, by inclined shores spiked to horizontal wooden yokes near the tops of the columns. The columns were delivered by trucks and unloaded and for short storage were set upright against the cellar wall by two stiff-leg derricks. After the second tier of beams was erected, one of the stiff-leg derricks was replaced by a guyed derrick with a 55-ft. mast 16 in. in diameter and a 65-ft. boom 16 in. in diameter with a capacity of about 15 tons. With these two derricks all the steelwork was hoisted and erected at the rate of about one tier, or 200 tons per week. On Sept. 15 three tiers of beams had been erected and the columns were set up to the fifth floor level. On October 1 seven tiers of beams had been erected and the most of the columns in the seventh and eighth stories were set. On October 15 eleven tiers of beams had been erected, most of the columns for the eleventh and twelfth stories and many of their floor beams and girders had been set, and the floor arches had been built in the first eight stories, the brick rear and court walls had been built up to the sixth story and the masons had commenced building the front walls at the first and sixth stories. On November 1, the steel framework was substantially completed except some riveting, the floor arches had been built to the thirteenth story. The front walls had been completed for the sixth, seventh, eighth, ninth and part of the tenth stories; the corner piers had been built in the first and second stories, and the brick rear and court walls had been completed up to the eleventh and twelfth stories.

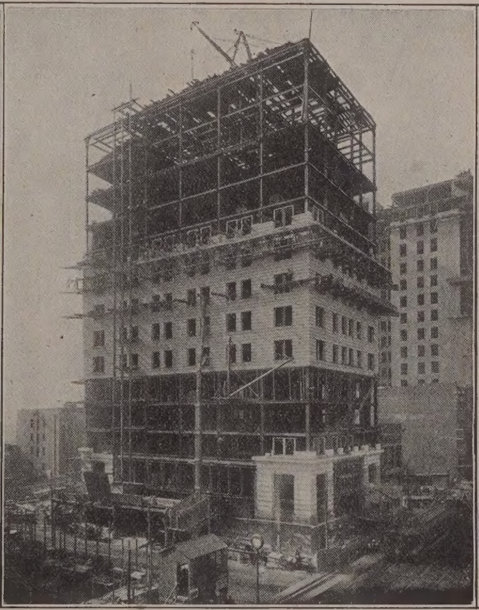
On November 15 all floor and roof arches had been completed, the front walls had been completed from the street to the third story and from the sixth to the thirteenth stories and the rear and court walls were finished. On December 1 the front walls had been completed, part of their masons' scaffolds and all of the masons' scaffolds on the rear walls removed, scaffolds built for the cornice work and stone cutters were at work on the carved ornaments of the third story. On December 15 all the principal outside scaffolds had been removed and the installation of the steam, electric, hydraulic, sanitary and mechanical equipment was well advanced. On January 1 the windows were all glazed, most of the interior partition, stair work, plastering, etc., nearly completed and the finishing and trim so far advanced that the building could be promised to be ready for tenants February 7, the anniversary of the destruction of its predecessor.

The stones in the street walls up to the sixth story were hoisted by mast and boom derricks fastened to the face of the steel framework; above the sixth floor they were hoisted by an outside elevator and distributed by trucks on the scaffolds. There were also two Thomas & Bulkley hod elevators to raise bricks and mortar inside the building, and an outside wooden chute extending from the street to the top of the building, with inclined branches at every story, to receive rubbish and discharge it to an elevated bin from which it was loaded into wagons for removal at convenience. The erection of the steelwork was facilitated by the fact that the columns were in two-story lengths and their cover splice plates were shop-riveted to the upper ends of each section. The derricks set two full tiers of steel from each position and were moved up two stories at once as soon as they had completed the second tier of beams above their own level. The stiff-leg derrick moved the mast and boom of the guyed derrick together and held them in position until their guys had been connected to the tops of the columns at the upper level. Then the guyed derrick removed the boom and stiff legs from their sills and lifted them separately and assembled them together at the upper level. About ten men, working about three hours were required to shift both derricks and each derrick was out of service about three hours.

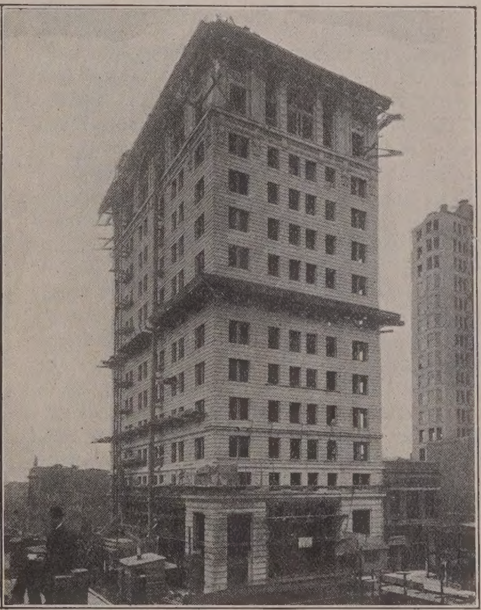
Mr. Otto G. Simonson was the architect and Purdy & Henderson, New York, were the consulting engineers for this building. The George A. Fuller Co., Mr. Paul Starrett, president, was the general contractor and erected the steel work which was fabricated by the Carnegie Steel Co. Mr. C. L. Pierson was the superintendent of erection and general construction and the contractors believe that the record of construction is one of the best ever made for such work.



Erection of Eighth Story, Oct. 1.



Steelwork Completed, Nov. 1.



Walls Completed, Dec. 1.

Legal Restrictions on the Use of Underground Water Supplies in New York.

Probably in no State have the rights connected with the development of underground water supplies for municipal purposes been passed upon by the courts more often than in New York. This has been due in a large measure to the construction and operation of driven wells on Long Island as a part of the Brooklyn water-works. These wells were sunk in a district mainly devoted to market gardening, and the suits for damages which have been instituted by property owners, on the ground that the wells injuriously dried their land, have had a marked influence on important engineering enterprises. One of the most instructive of these suits is that of Frederick Reisert against the City of New York, which has already traversed the scale of State courts, from lowest to highest, and is now on its way upward for a second time. On Jan. 20 of this year it was before the Supreme Court, Appellate Division, where an opinion of much importance to designers of water-works in New York was rendered by Judge Hooker, the other judges concurring. On account of the influence of this decision on a leading branch of engineering work, it is printed in full, as follows:

The plaintiff sues for past damages and a permanent injunction restraining the operation of defendant's pumps and driven wells near his farm. It was admitted upon the trial that the operation of these wells had lowered the natural level of the subterranean waters under the plaintiff's property, and it was there conceded that the only question in the case was the extent to which the pumping stations had lowered the water table, and any damage traceable thereto. The sixth finding of fact is as follows: "That by reason of said pumping and trespass on and to the plaintiff's land and premises the plaintiff, during the past ten years, has suffered no damage to the rental value nor to the fee value of said premises."

The opinion of the learned trial court, delivered in deciding this case, and its rulings upon the trial, make it clear that it adopted the measure of damages which has been determined to be the correct one governing cases of this kind. Applied to the facts in this case, the rule of damages as laid down by the decision of the Court of Appeals is to what extent the rental value of the lands, as affected by the diversion of the water, had been substantially injured. Judge Bartlett, for the Court of Appeals in this case, has written these pertinent sentences (p. 735, 66 N. E.):

"In regard to the position of the defendant in this and kindred cases, it appears that since the year 1884 it has seen fit to occupy the position of a naked trespasser, and sought to justify its action on the ground of paramount necessity arising from the requirements of a great city for an adequate supply of pure and wholesome water.

"If it is necessary, in the public interest, for the defendant to subject the inhabitants of Long Island to the damages incident to maintaining a large number of pumping stations and driven wells, depriving extensive sections of the country of its underlying and percolating waters, as well as drying up its surface streams and wells, the least it can do is to meet plaintiffs in a spirit of fairness, eschewing technicality, and ascertain their actual damages in the premises, and, if not contented to pursue such a course, to institute condemnation proceedings. It is true that the rights of the individual must yield to public necessity, but it should always be kept in mind that this result can only be fairly and legally accomplished by duly compensating the citizen for property damaged or destroyed."

The evidence and the findings in this case establish beyond the possibility of dispute, under the rule announced by the Court of Appeals in the Forbell case (58 N. E. 644), that the defendant is a naked trespasser; and if the plaintiff has sustained any damage whatever, and is likely to sustain any in the future, by reason of the trespass, he is without doubt entitled to an injunction; and if, on the trial of these questions, adequate proof is offered tending to show what the extent of his injury has been within the six years prior to the commencement of the action, under the proper measure of damages, he is entitled to a judgment for that amount. The sixth finding of fact—that the plaintiff has suffered no damage to his premises—is insufficiently supported by the evidence, and the judgment must be reversed for that reason.

The pumping plant commenced its operation in or about the month of May, 1885, within a few hundred feet of the plaintiff's premises. Prior to that time a clear stream ran on the western boundary of plaintiff's land for a portion of its course, and for a distance flowed through one corner of his farm. Before the pumps began to operate, this stream was between 1 and 2 ft. deep, and in some places 3 ft. Holes 6 ft. in depth existed. At the southerly portion of the farm the stream ran into and across plaintiff's land, and at that point, before the commencement of the operation of the pumps, the plaintiff had started the establishment of a game and fish preserve, where he owned both sides of the stream. It was used for watering produce, horses, cattle, and for raising trout and water cresses. It was unnecessary at that time for the plaintiff to pump water for domestic or farm use. He had raised trout in the stream, which abounded there, and these he used for himself and sold.

The conclusion is irresistible that by reason of the maintenance and operation of the pumping stations this stream has practically dried up, and such water as is found in its bed now is surface water; and although, immediately following rains, water flows through the creek, the flow soon stops, and what water remains is stagnant. Prior to the trespass the stream was permanent, did not dry up in summer, and seldom froze over in the winter time.

The plaintiff produced expert evidence tending to show that the difference in the fair rental value of his farm in the absence of the pumping station was considerably greater than it was by reason of the operation of the pumps, in conformity with the rule announced by the Court of Appeals in this case. The court admitted all the evidence tending to show the character and use made of the lands, the nature of the crops grown thereon, and the business conducted there, together with the gross and net income, prices, fertilizer, manure, and the help in the various years both before and after the trespass.

The plaintiff's expert evidence was based upon these circumstances and conditions, taken in connection with the effect upon agriculture which a considerable lowering of the water table would entail. The defendant called a number of experts, some of whom were farmers, the burden of whose testimony was that the lowering of the water table would not have any effect upon the productiveness of the soil such as existed on Long Island in the vicinity of the plaintiff's premises, and that the rental or usable value of plaintiff's premises was not affected or diminished by reason of the consequences following from the defendant's trespass. The plaintiff had occupied and worked the farm himself since the year 1883, and, in the absence of its having been rented, either during the continuance of the trespass or otherwise, proof of the rental or usable value was difficult to obtain.

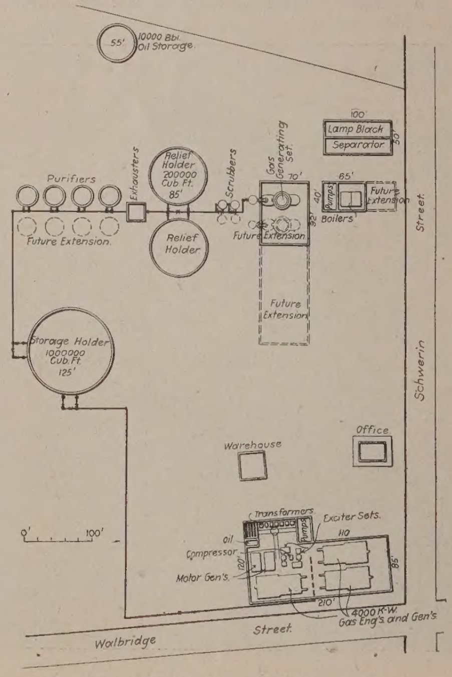
The Court of Appeals held upon the prior appeal in this case that evidence of the character and extent of the use made of the lands and of the nature of the crops and business conducted there, together with evidence of the income, both gross and net, expenses, prices, fertilizer, manure, and help, when in their normal and usual condition as to subterranean waters, and also when deprived thereof, was competent as tending to show usable value. It is clear that, unless direct proof of the usable value was offered, based upon actual rentals, under conditions which would suggest that fair rent was being paid therefor, experts who might undertake to swear to the fair usable rental value could not give adequate answers, or give the court valuable information to guide it in awarding damages, without taking into consideration all the conditions to which we have referred, and which the Court of Appeals has said is competent on this question. It is clear from the record that the defendant's experts did not testify upon a consideration of such facts and circumstances, and especially is it true that none of them was asked or appeared to consider the rental or usable value in the presence or absence of the natural stream at the westerly end of the plaintiff's farm. The conclusion is irresistible, from a consideration of this record, that the plaintiff has suffered damage other than the sole item of $90, the cost of driving his wells further into the ground, which the court has allowed.

Both parties ask this court that, in the event of a reversal, final disposition should be made of the matter. The judgment of reversal should therefore contain a direction that an injunction issue restraining the defendant from maintaining and operating its conduit lines and pumping stations, and from diverting the surface and subterranean waters, not to become operative, however, if within a reasonable time (to be fixed by the judgment) the defendant pay the plaintiff the value of the right to maintain and operate its conduit lines and power station as against the plaintiff, the amount to be appraised by commissioners duly appointed; and the judgment should further provide that the action be remitted to the Special Term for the purpose of appointing a referee to take evidence and determine the amount of the plaintiff's damages, with costs to the appellant.

A Power Plant With 5,000 H.-P. Gas Engines.

The California Gas & Electric Corporation, which owns and operates one of the longest and best equipped electric transmission lines in the world, has recently entered into a contract with the United Railways Co., of San Francisco, to supply the electricity for running the entire street railway system under the control of that company. Current will be supplied normally from the hydro-electric transmission system, but to provide against interruption of service, it was considered desirable to arrange for the installation of an auxiliary power plant to pick up the load quickly, if necessary, and so insure constant service to the street railway company.

Steam engines and steam turbines were considered, but the fact that they require that their boilers shall be under constant fire for immediate operation was considered to involve too much attendant expense. The engineers, therefore, decided upon the introduction of large gas engine units, which are ready for instant use, and with which the interest on the cost of the engine plant is the only fixed expense.



Gas Engine Station, San Francisco.

The California Gas & Electric Corporation, in addition to its other work, has been the pioneer in California in the manufacture of an excellent quality of low cost oil gas, and is now proposing to introduce the largest gas engines that have ever been constructed in the United States to be used directly connected to alternating-current generators operating in parallel. The engines, of 5,333 h.-p. each, three in number, will be constructed by the Snow Steam Pump Works, Buffalo, N. Y.

The Snow engine is of the four-cycle, horizontal twin-tandem, double-acting type, giving two impulses to each crank per revolution. The equipment of the station for the present is to consist of three of these engines. They will be of 5,333 h.-p. each, will run at 88 r.p.m., and will each be directly connected to a three-phase, 4,000-kw., 25-cycle alternator, manufactured by the Crocker-Wheeler Co. There will also be two motor-generator frequency changers, built by the Stanley Co., having an output of 4,000 kw. each, and designed to run at 300 r.p.m.

The main building of the power station will be 200 ft. in length by 90 ft. in width. This will accommodate three engines, motor-generators and exciter sets, and will also give room at one end for a machine shop, tool room and office rooms, etc. On one side of the main building there will be an addition 36 ft. wide by 80 ft. long, in which will be installed on the first floor a storage battery, high-tension transformers and pumping apparatus for cooling water for the gas engines; on the second floor the high voltage switches and the general operating switchboard of the power station.

Outside of the main building there will be arranged storage tanks, cooling tanks and other apparatus for the cooling water of the engines.

In connection with the gas engine station, there will be an oil gas plant, consisting of generators 16 ft. in diameter by 18 ft. in height, connected to superheaters 16 ft. in diameter by 40 ft. in height, and specially designed wash boxes for removing the by-product, lamp black. The works will be fitted with scrubbers and two relief gas holders having a capacity of 200,000 cu. ft. each. There will be four cylindrical purifiers 30 ft. in diameter and a storage gas holder of 1,000,000 cu. ft. capacity.

The plans of the works are now finished and construction work is about to begin. The site selected is in San Mateo County, a distance of about 4½ miles from the center of the business district of the city of San Francisco, and is particularly ideal, being located on the bay of San Francisco where oil can be readily delivered, and where salt water for all purposes in the manufacture of gas can be obtained in unlimited quantities.

The low cost of crude petroleum in California makes it possible to produce a gas of high heating value at a cost which is impossible in many other parts of the country. It is the endeavor of the corporation to complete the gas plant by Sept. 1, 1905, and the managers hope to have one of the engines installed at that time, and that the complete installation will be finished before Jan. 1, 1906.

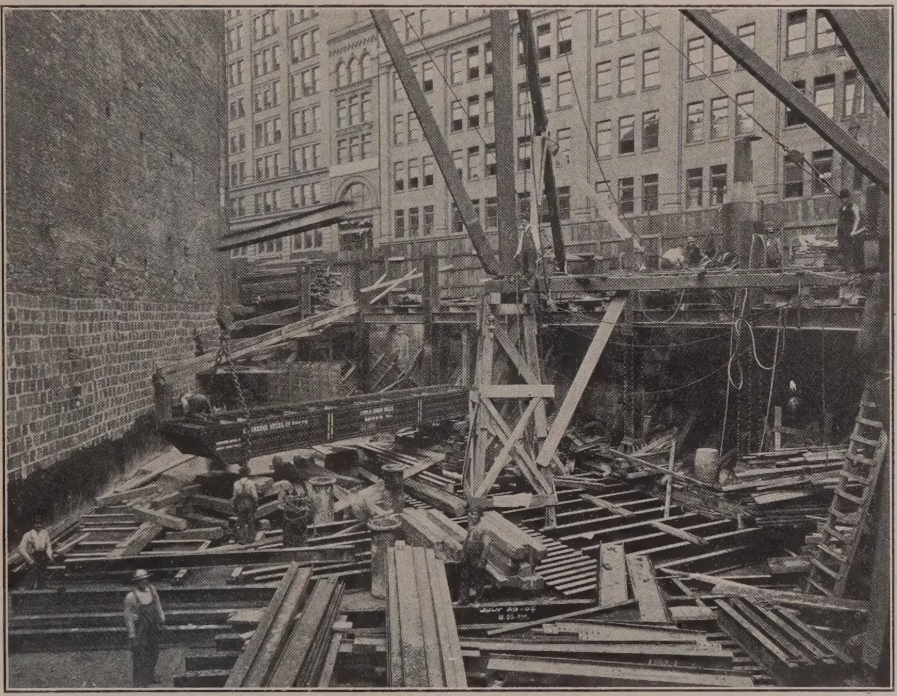
The construction of the power plant, including buildings, and the gas engine units, together with the high-potential transmission lines, which will connect the power station with the seven water-power plants of the corporation, will be in charge of F. G. Baum, transmission engineer of the corporation, who has achieved a wide reputation for his knowledge in this branch of electrical science. The erection of all of the gas plants and all of their equipment will be in immediate charge of E. C. Jones, gas engineer of the corporation, who is a well-known authority on the construction of gas works and in their economic operation.

The Crushing Strength of Tile has been examined by the National Fire Proofing Co.'s Chicago office, under the direction of Mr. E. V. Johnson, vice-president and western manager. He built a pillar of solid, porous Hobart partition tile, taken at random from stock and laid up in lime mortar to which a little cement was added. The pillar had three sides perfectly plumb, and it was 3 ft. ⅛ in. long, 3 15/16 in. wide and 12 ft. 3¼ in. high. The first, third and every odd-numbered course consisted of three whole blocks; the second, fourth and every even numbered course consisted of two whole and two half blocks, one of the latter at each end. No indications of failure were observed until a load of 20 tons was applied, when a slight buckle was noticed and a crushing of the tile half-way up the pillar. At 22½ tons a decided buckling occurred, which continued until the maximum pressure of 34 tons, 477 lb. per square inch, was reached, when failure took place on account of the buckling.

The Diamond Bank Building, Pittsburg.

The Diamond Bank Building, at the corner of Union St., Fifth Ave. and Liberty St., Pittsburg, is a twelve-story and basement steel-cage fireproof office building which occupies an irregular five-sided area about 121½x59½ ft. in extreme dimensions, the long side being adjacent to another tall building. At this place the street is sometimes flooded by extreme high water in the river, and provision was made to resist a possible maximum head of 20 ft. for the basement and vault retaining walls and for the upward pressure on the basement floor. This involves special features in the steel construction for the substructure, besides which there are interesting details in the distributing girders and trusses for the main columns, in the arrangement of the floorbeams and girders, and in the details of wind bracing, cornice construction and suspended floor for a pipe room above the ceiling of the upper story.

High-water level is at the elevation 33.5 and the first-floor level is at elevation 36. The excavation was carried down over the entire area of the building to elevation 13.5, and was made with some difficulty by the use of steam pumps and a permanent sheet-pile cofferdam driven around the building just outside the vault lines, which are from about 7 to 14 ft. beyond the building lines on four sides. The hard, fine gravel in the bottom of the excavation was leveled and covered with 1:2:5 Portland cement concrete 8 in. thick under the column footings and slightly arched between them, as shown in the general cross-section. The surface of the concrete was covered with a 1-in. layer of tar and felt waterproofing in several thicknesses, which was flashed up on the inner surface of the sheet piling to the curb level.


Setting Grillage and Foundation Beams.

A second 8-in. layer of solid concrete was placed on the waterproofing, and on it was seated the lower tier of grillage beams. These beams, mostly 12 in. deep and about 1 ft. apart, were arranged in groups to form footings for single columns or sets of two, three and eight columns. In each group they were connected by ¾-in. tie-rods and gas-pipe separators 4 in. above the bottom flanges. In order to provide a continuous reinforcement system against upward deflection from the possible hydrostatic head under the concrete, the groups of beams were connected by parallel horizontal beams in the same plane, which were arranged to cover all the spaces between the footings and thus form a continuous framework over the whole area of the building and the sidewalk vaults. The depths of these beams varied according to their lengths from 8 in. to 18 in., and they were spaced from about 2 to 5 ft. apart, averaging 2½ or 3 ft., except near the center of the building, where they span about 25 ft., and are 18 in. deep and 22 in. apart. Their webs are generally in the planes of the webs of every third or fourth grillage beam, to which they are connected by double splice-plates. In some cases they are at right or oblique angles to the grillage beams and are connected by short vertical angles to them.

The outer ends of the beams under the sidewalk vault are riveted through their top flanges to the horizontal webs of 12-in. channels in the planes of the retaining walls. These channels form sills for vertical 12-in. I-beams 5 ft. apart, which are web-connected to them by short angles or bent plates, and at their upper ends engage a similar horizontal continuous channel, flanges down, on which the outer ends of the sidewalk beams are seated. The vertical beams are enclosed in a solid wall of concrete about 20 in. in maximum thickness, with flat inside and outside surfaces.

For nearly all of the columns separate upper tiers of grillage beams at right angles to those in the lower tiers were carefully leveled with a 1½ to ¾-in. mortar bed or grout between them. Usually each set consists of three or four beams from 15 to 24 in. deep, and long enough to reach across the lower tier. Columns 4, 8, 12, 2, 5, 9, 13 and 7, 3, 42 are carried on three heavy triple web plate-girders from about 4 to 5½ ft. deep. Cast-iron bases accurately leveled and grouted are seated on the top flanges of the grillage beams and distributing girders, and distribute the column loads uniformly upon them. The interstices between the beams and girder webs are filled with grout or concrete and enclosed in a solid mass of concrete, with which the entire area of the excavation was leveled up to the basement floor, providing a total thickness of 6 ft. of concrete throughout. This suffices to enclose most of the cast-iron column bases, and where they project above the floor they are covered by brick corbelling extended from the brick shell with which the column is enclosed in the basement story. All concrete was made with Atlas Portland cement hand mixed.

The grillages were proportioned to distribute the column loads and reduce them to a uniform pressure of 4 tons per square foot on the gravel.

The superstructure is carried by forty-two rectangular closed columns arranged in rows parallel to the outer walls of the building, as indicated in the beam plan. It is proportioned for a total dead and live load of 250 lb. per square foot on the first floor, and for 160 lb. on the roof and all upper floors. The outer walls are of granite up to the fourth story and above it of brick and terra-cotta. They are carried independently of the floors by wall girders directly connected to the columns at every story. A wind pressure of 30 lb. per square foot of vertical exterior surface is provided for, and the resultant stresses are assumed to be resisted by the general rigidity of the building, except in the direction perpendicular to the longest side, where the main floor girders are proportioned to receive it. These girders are generally pairs of 15, 18 and 20-in. I-beams on opposite sides of the columns and connected with the latter by heavy rectangular connection plates with field rivets proportioned to take the maximum stresses.

All columns are made in six sections of 1, 2, 3, 3, 2 and 2 stories in height, commencing with the basement section, which is 18 ft. 8 in. long. The three-story sections are 34½ ft. long and the upper sections are 23 ft. long, and have a uniform sectional area of 8.82 sq. in. This is made with a pair of 9-in. channels and two 14x5/16-in. cover-plates proportioned for a maximum load of 7,200 lb. in the eleventh story and 4,600 lb. in the twelfth story, where the cover-plates are omitted and the channels are latticed. The basement section of column No. 2 has a maximum cross-section of 56.6 sq. in., and is proportioned for a load of 366,000 lb. It is built with two 15-in. 35-lb. channels and four 16x9/16-in. cover-plates. All column joints are 2 ft. above the floor levels and are made with a pair of flange cover-plates shop-riveted at the lower end and field-riveted at the upper end. Where the dimensions of the column change, the splice-plates are beveled to correspond, and a ¾-in. horizontal bearing plate is inserted between the milled ends of all columns, and is field-riveted to horizontal connection angles on both. A typical detail of an interior column is shown by the drawing of column 9 at the eleventh floor. This column is duplicated for eight other columns. The construction of the wall columns is substantially the same.

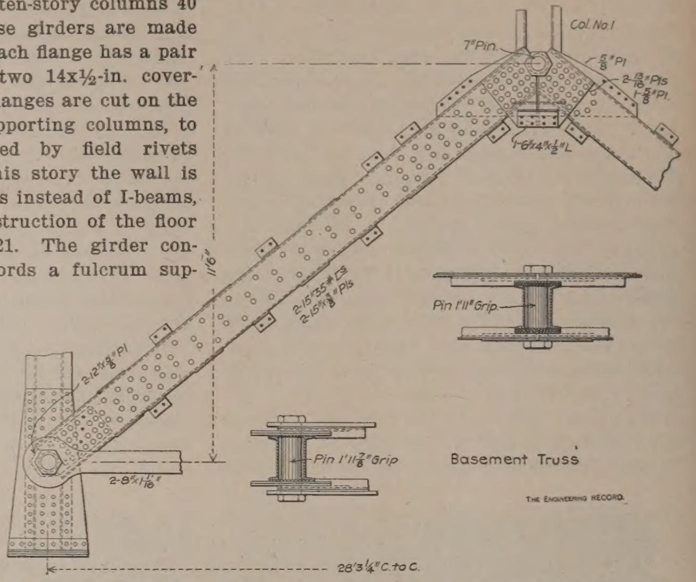
The bases of columns 2 and 42 are made special to receive connections to a triangular truss which supports column 1 at the first-floor level. By this arrangement the load from column 1 is transmitted to the grillage footings more conveniently and economically and with less obstruction to the basement than would have been done by seating the three columns on a distributing girder, which would have been very heavy. The truss is comparatively light, and being contained in the plane of the outer wall columns, does not take up any extra space. It is a simple triangular frame made with two inclined struts and a pair of horizontal eye-bars. The upper ends of the struts have separate projecting gusset plates independent of each other, except that after erection they were connected by a field-riveted horizontal shelf angle which supports a beam in the first floor. They project beyond the outer flanges of the struts to afford web connections for beams at right angles to the one first mentioned, and short connection angles are riveted to the channel flanges and to the vertical I-beams in the vault retaining wall adjacent to the neighboring building.

The beam plan for the fourth, fifth and sixth floors is typical of the framing in all of the stories between the sixth and twelfth, inclusive, and shows the peculiar arrangement of diagonal beams and girders in the center of the building around the elevator shafts. The light court is open from the third story to the roof, and the outside walls are braced together across it from column 4 to 22 by struts at the sixth, ninth and eleventh stories. In some stories the wall girders are located as shown a little beyond the outside faces of the columns, and in others they are more nearly on the center lines of the columns, but they are everywhere connected to the face of the columns on Union St. and to the webs of the double girders on Fifth Ave. and Liberty Ave., and on the opposite side of the building, except where those girders are omitted and they engage the columns directly. In the first floor the wall girders are heavily loaded by the granite masonry, and each panel usually consists of an 18-in., a 20-in. I-beam, and an inner 8-in. channel.

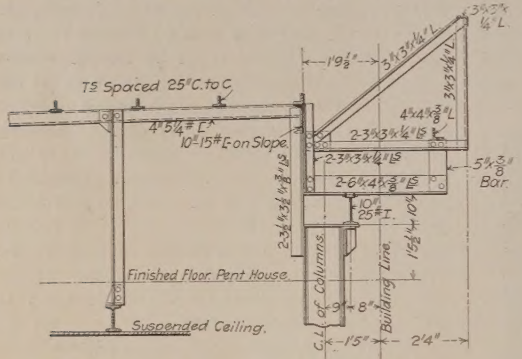
In the first, second and third floors the space between columns 12, 23 and 22 is covered by 12-in. I-beams 12 in apart, carried at both ends on solid walls and not carried by the girder 12-23, which supports only the beams and girders on the opposite side. The 12-in. I-beams support solid concrete slabs forming the floors of a three-story pier of fireproof vaults. In the third-floor columns 37-39 and 36-38 are connected by pairs of heavy plate-girders, which support in the middle the ten-story columns 40 and 41, respectively. These girders are made with a 42x½-in. web, and each flange has a pair of 6x6x¾-in. angles and two 14x½-in. cover-plates. The ends of their flanges are cut on the inner side to clear the supporting columns, to which they are connected by field rivets through their webs. In this story the wall is also carried on plate-girders instead of I-beams, and there is a special construction of the floor between columns 18 and 21. The girder connecting these columns affords a fulcrum support for 8-in. I-beams about 6 ft. long, which are riveted at one end to an interior floorbeam and are supported 17 in. from the other end on the top flange of the girder, beyond which they project to form a cantilever platform required for the architectural features of the entrance.

Except in the middle of the building, where there is a steel-frame one-story pent house and skylight above it, the roof may be used for a future thirteenth floor, and is elevated above the beams and girders which form the ceiling of the twelfth story by angle-iron columns about 5 ft. high, so as to form a pipe chamber between the ceiling and roof. These columns support 4-in. transverse channels that carry 3x3-in. longitudinal Ts about 2 ft. apart, on which the tiles are laid. The main columns extend about 1½ ft. above the pent-house floor and are connected by horizontal 10-in. beams serving as fulcrums for the cantilever framework of the cornice, which is anchored, as shown in the detail, to vertical angles on the inner face of the columns.

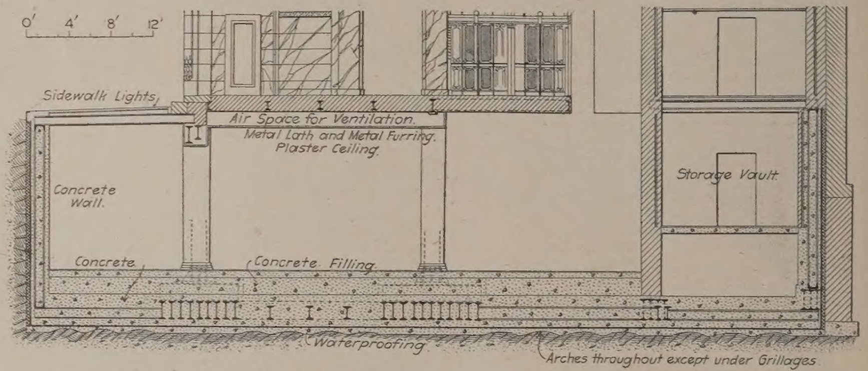
The heaviest members in the building are the distribution girders in the foundation grillages. Girder 213 is 39 ft. 1⅞ in. long, 5 ft. 3½ in. deep, and 36 in. wide over all, and weighs about 70,000 lb. It is substantially symmetrical about the center line, except that one end is beveled as shown, and the oeher end is square. The three complete plate-girders of which it is composed were shop-riveted together through the flange cover-plates. At the ends of the middle girder the web-plates are double, but are riveted together through the flange and



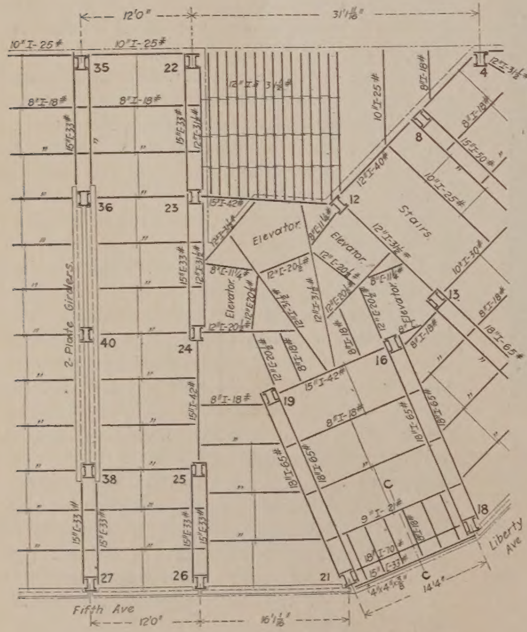
Basement Truss



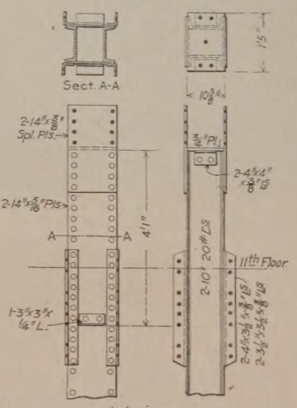
Cornice and Suspended Ceiling.



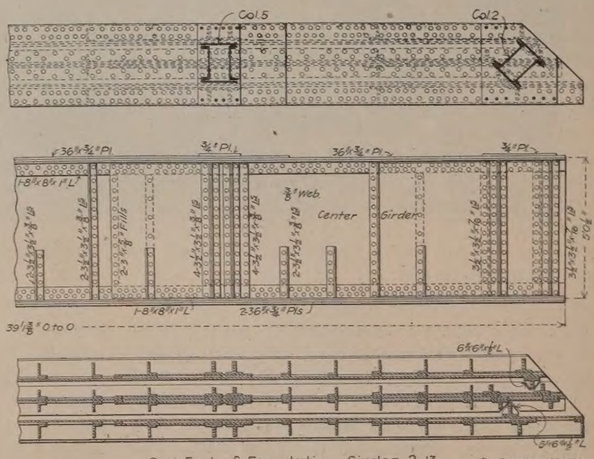
Typical Transverse Section of Basement.



Part Plan of Third Floor showing Plate Girders



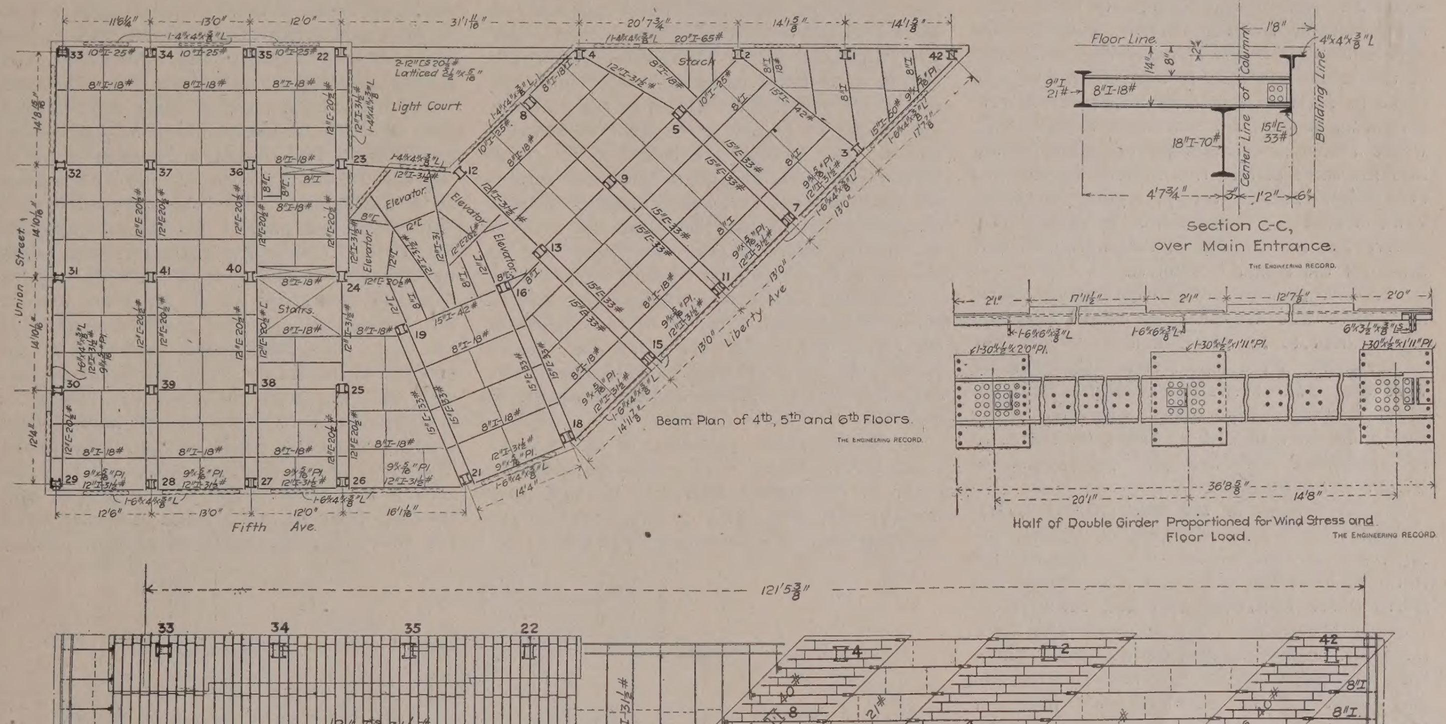
Interior Column 9 at 11th Floor.



One End of Foundation Girder 2-13

Special Steel Work in Diamond Bank Building, Pittsburg.

vertical stiffener angles only. In the middle of this girder and throughout the side girders the webs are single ⅜-in. plates. All stiffener angles are milled to bear at both ends, and a clearance of 1 in. is left between the ends of web-plates at their splices. The depth of the girder from back to back of angles is ½ in. greater than the height of the web-plate.


Beam Plan of 4th, 5th and 6th Floors.
Light Court
Elevator
Stairs
Union Street
Fifth Ave.
Liberty Ave.
Section C-C, over Main Entrance.
Floor Line
Center Line of Column
Building Line
Half of Double Girder Proportioned for Wind Stress and Floor Load.
121′5⅜″
15″ I for Footing of Is in Retaining Wall.
0′ 4′ 8′ 12′ 16′
Foundation Plan, Lower Grillage and Reinforcement Beams for Floor Concrete.
THE ENGINEERING RECORD.

Foundation Grillage and Reaction Beams and Typical Beam Plan, Diamond Bank Building.

McClure & Spahr, Pittsburg, are the architects of the building, and the steel work was designed by Mr. S. C. Weiskopf, consulting engineer. The structural steel weighed about 1,100 tons and was fabricated by the Carnegie Steel Co. James Stewart & Co., of New York and Pittsburg, were the general contractors.

Double-Voltage Generators are in use in the power station of the Darlington, England, traction system, where each direct-current dynamo gives 460 to 500 volts as a shunt machine for lighting supply and 500 to 550 volts as a compound machine for traction. There are two 50-h.p., two 150-h.p., and two 350-h.p. units.

Pacific Coast Water Powers for Electrical Railroad Operation.

The use of Pacific Coast water powers in the electrical operation of railroads was the subject of a paper read before the Pacific Coast Railway Club on Jan. 21, in San Francisco, by Mr. Robt. McF. Doble. The advantages of electric traction over steam for the operation of railroads were considered under three heads, viz.: (1) Those appealing to the passenger and resulting in an increase of traffic; (2) those pertaining to the centralization of power; and (3) the economies in first cost, maintenance and operating expenses.

Under the advantages to the passenger were mentioned freedom from dirt and smoke, cleanliness and better ventilation and lighting of cars. Reference was made to the possibility of obtaining higher average and maximum speeds with electric operation and to the greater tractive effort resulting from the increased weight on the driving wheels.

Under the advantages of a central power station, particular reference was made to the water powers at frequent intervals from Southern California into British Columbia. While only a few of these powers have been developed, the conditions would seem to make profitable the operation of at least some of the railroads by electricity. The capacity of the steam locomotive has to be that of the maximum effort required from it, even though that effort be for a very short time, while on the other hand, the load on the power station is only the sum of the loads on the different motors, which will average much less than the sum of their maximum powers. This materially reduces the cost of operating, especially with the conditions found on the Pacific Coast, where several power plants can feed into one network and supplement the power of each other. In such a system of distribution as is possible in California, considerable power might be generated by trains descending mountain divisions and thus fed back into the distribution net work.

Under the third heading, claims were made for a saving in the cost and maintenance of track, a possible increase in capacity of existing railroads, a saving of time and labor in the operation of an electric locomotive, and for its characteristic simplicity and the rapidity with which repairs can be made. The power which can be obtained from steam locomotives is rapidly approaching its limit, while the development of the electric locomotive has apparently only begun. The relative reliability of the steam and electric locomotive was held to be in favor of the latter, especially in consideration of the local conditions in California, where a number of water power plants feeding into the same distribution system would make exceedingly remote the possibility of break down of anything more than an individual locomotive, and the chances for that were only half those for the steam locomotive.

The 6,000 type of New York Central electric locomotive was described in detail, attention being called to its power and speed qualities as developed in the recent tests. Comparisons were also made between the electric and the heaviest Atlantic type steam locomotive of the New York Central, with particular reference to the increased draw-bar pull per pound of weight of the former.

The advantages of the multiple-unit direct-current system were next treated, mention being made of some of the typical installations in the Eastern States and of the Key Route and North Shore Railroads near San Francisco.

Under alternating current polyphase systems, Mr. Doble described the Valtellina, Jungfrau, and Burgdorf-Thun systems. Mention was also made of the Berlin-Zossen high-speed trials.

Single-phase systems were next taken up, attention being called to the pioneer work of B. J. Arnold, the General Electric and Westinghouse systems and their special features, and the system designed by J. H. Hallberg.

Turning to the achievements of electric traction in California, particular reference was made to the Los Angeles & Redondo Ry., the Pacific Electric Ry. of Los Angeles, and the North Shore and Key Route systems of San Francisco. The North Shore R. R. is of special interest by reason of its being the first and only third-rail line in California, and because of its being operated from a substation which is the terminus of one of the longest transmission lines in the country. The Alto station referred to is 180 miles from the hydro-electric plant at Colgate and 250 miles from the new De Sabla power house. One of the features of the Key Route system which was given considerable attention was the diamond trolley, which is successfully used on all of its trains. The possibilities of this collector for heavy railroad work were pointed out.

As to projected electric lines on the Pacific Coast, reference was made to improvements which the Southern Pacific Co. has under consideration for its suburban lines in Oakland, Berkeley and Alameda, to the rumored electrification of that company's San Jose and Port Costa lines, and also to the possibility of operating its mountainous divisions by electricity. Mr. Doble concluded with some very interesting remarks on the leading hydro-electric power stations and transmission systems of California. The distinguishing characteristics of each plant were mentioned and special reference was made to the new De Sabla power house of the California Gas & Electric Corporation, where is now operating an 8,000-h.p. tangential water wheel, the largest single water wheel ever constructed. This station regularly supplies power to San Francisco and other points over 300 miles distant.

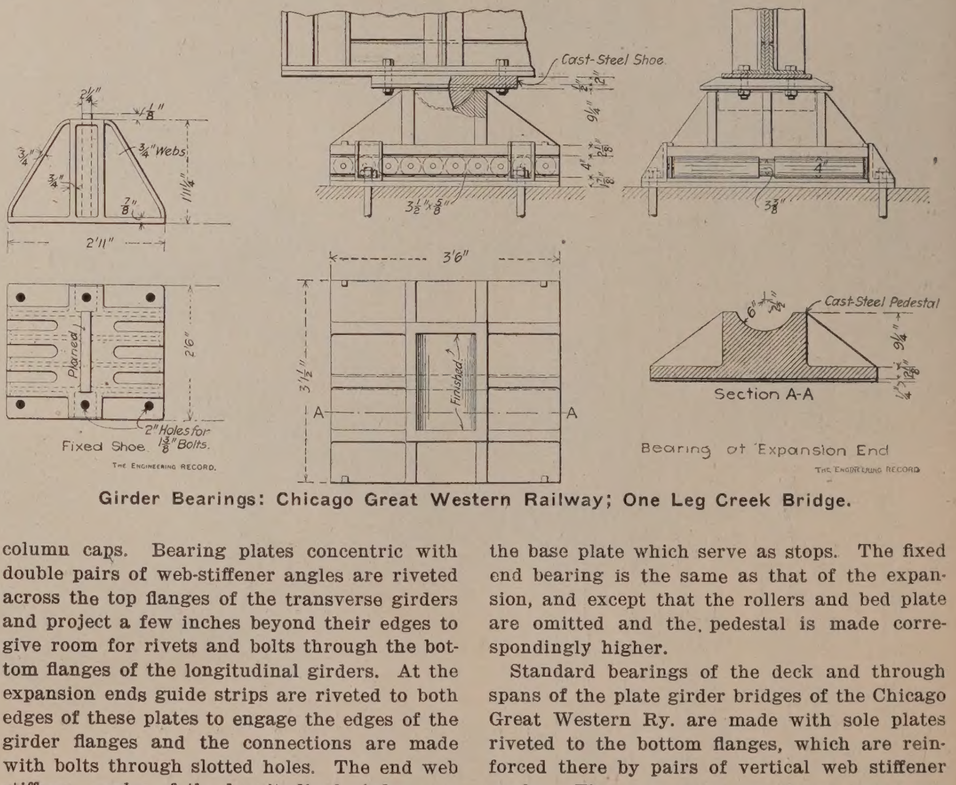
Types and Details of Bridge Construction: Plate-Girders.—XIII.

By Frank W. Skinner, C. E.

Miscellaneous End Bearings.—The expansion ends of the longitudinal girders of the Detroit Union Depot Viaduct have their lower flanges seated on the horizontal upper surfaces of castings 13 in. in diameter. These castings are made with two semicircular webs in planes parallel with that of the transverse girder and having their lower edges seated on a U-shape suspension pocket-plate riveted to the outstanding flanges of a pair of vertical web-stiffener angles. The castings are bolted to the transverse girder webs and the longitudinal girders are not in any way fastened to them. The edges of their lower flanges just clear the faces of the pocket plates so that the latter act as guides, and prevent transverse displacement. Longitudinal movement is limited by a pair of short vertical angles bolted to the insides of the pocket plates after the girders are seated in the pockets, and forming stops to engage the end vertical web-stiffener angles, as shown on page 109.

The double track approaches of the Pennsylvania & New Jersey R. R. across the Delaware River at Bridesburg, Philadelphia, have four lines of 40-ft. deck plate girders seated on the top flanges of the transverse girders and on the column caps. Bearing plates concentric with double pairs of web-stiffener angles are riveted across the top flanges of the transverse girders and project a few inches beyond their edges to give room for rivets and bolts through the bottom flanges of the longitudinal girders. At the expansion ends guide strips are riveted to both edges of these plates to engage the edges of the girder flanges and the connections are made with bolts through slotted holes. The end web stiffener angles of the longitudinal girders are set back about 4 in. from the ends of the webs so as to clear the pair of cover splice plates which connect the webs of the adjacent girders and are field-riveted at fixed joints and bolted through slotted holes at expansion joints.

Standard bearings for long-span plate girders on the Wabash R. R. are illustrated by those for a single track skew through bridge of two 85-ft. spans on the Toledo division over One Leg Creek. The bridge is proportioned for a live load consisting of a train weighing 5,000 lb. per lin. ft., preceded by two coupled locomotives each with 50,000 lb. on each of four axles, 5 ft. apart. One girder is designed for future service as the center girder of a double track bridge, and its bearings are cylindrical to provide for deflections or inequalities of setting and are fixed for both spans on their common center pier, and have expansion provision on both abutments. An 18x27-in. sole plate is riveted to the lower flange of the girder, and to it is bolted a cast steel bearing plate 24 in. wide and 2 in. thick, on the bottom of which is a finished segment of a transverse cylinder 12 in. in diameter and 18 in. long with a versed sine of 4 in. This segment engages a corresponding recess with a versed sine of 2½ in. in the top of a cast steel pedestal with its base extended to 37½x42 in. and stiffened by vertical transverse and longitudinal ribs. The space between the inner sides of these webs is solid, thus forming a heavy block to receive the girder load. The pedestal is seated on a nest of ten 4-in. rollers of the usual type with a guide strip in the center. The rollers are seated on a 46½x42-in. bed plate 1 in. thick, with nine longitudinal 3-in. bearing strips riveted to the upper surface. The ends of the roller are enclosed by side strips 3½ in. wide, but there is no provision for enclosing the sides of the rollers nest. The longitudinal movement of the pedestal is limited by a pair of clamps on each side, with which are cast steel lugs, Z-shape in cross-section, held down by the anchor bolts through the outer edges of their base plates. They are set on the bed plates, clear of the rollers, and their upper flanges project over the base plate of the pedestal and have about 2-in. clearance from small vertical projections on the base plate which serve as stops. The fixed end bearing is the same as that of the expansion, and except that the rollers and bed plate are omitted and the pedestal is made correspondingly higher.



Girder Bearings: Chicago Great Western Railway; One Leg Creek Bridge.

Standard bearings of the deck and through spans of the plate girder bridges of the Chicago Great Western Ry. are made with sole plates riveted to the bottom flanges, which are reinforced there by pairs of vertical web stiffener angles. They are seated on planed transverse ribs about 1⅛ in. high and 2 to 2½ in. wide on top of cast steel pedestals with transverse and horizontal webs and tops and bottom plates. For short spans these pedestals are alike at both ends, except that at the expansion ends they have slotted holes for the anchor bolts through them and the girder flanges and a ½ in. masonry plate. Where two spans are supported on the same pier, the pedestals are double and each is made with two seats.

For long spans the expansion end pedestals have longitudinal guide ribs on the lower surface and engage nests of cylindrical rollers on cast steel bed plates with longitudinal grooves and side guide ribs on the upper surface. The roller frames are made with cast steel longitudinal pieces and transverse angles all deep enough to nearly close the space between the pedestals and the bed plate, and thus protect the roller nest from dirt, snow, etc. The pedestals are bolted to the girder flanges and the bed plates are anchor-bolted to the masonry by two diagonally opposite 1¾ in. bolts 3 ft. long. In some cases the fixed-end pedestals are identical with those at the expansion ends and are seated on cast steel bolsters just high enough to compensate for the combined height of the rollers and bed plate and so keep the masonry at the same elevation at both ends of the span. In other cases the fixed end pedestal is made high enough to dispense with the bolster.

On the Union Pacific R. R. standard plate girder bridges up to 100 ft. long are designed with several different types of bearings on the pier and abutment masonry. The shortest and lightest spans have simple sole plates and rolled steel masonry bed plates; longer and heavier spans have webbed cast iron pedestals to distribute the loads and reduce the masonry pressure. Deck spans up to and including 70 ft. long have flat bearings sliding at the expansion end. Spans of 80 ft. and over have pin-bearings with shoes supported on rollers at the expansion ends and on fixed pedestals at the opposite ends. Through spans of 65 ft. and over have pin bearings with their shoes supported on rollers and pedestals of different types from those used for the deck spans.

Single-track spans of nearly 20 ft. are made with three 20-in. rolled I-beams under each rail instead of single riveted plate girders. Each set of beams has an 8x¾x31-in. transverse sole plate riveted across the ends of the lower flanges and seated on 9x¾x32-in. bed plate. Both sole and bed plates are unplaned and two 1¼-in. anchor bolts between the girders at each end pass through 1⅜-in. holes in both plates.

All girders except those with pin bearings have sole plates riveted to their bottom flanges and planed to grade so as to have the bed plates of pedestals set horizontal.

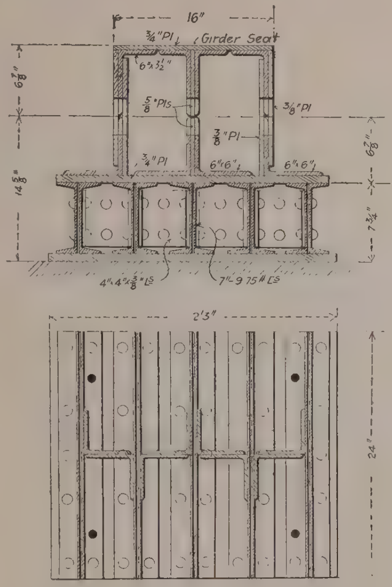
Deck single track plate girders 30 ft. long have ¾-in. sole plates 14 in. wide and 16 in. long riveted to their 6x6-in. flange angles and are seated on unplaned 18x¾x18-in. bed plates. A pair of 1¼-in. rag bolts 12 in. long pass through holes in the flange angles at both ends, those at one end being 1⅜ in. in diameter, at the other being slotted to 1⅜x2½ in. The bearings for the 40-ft. single track girders are the same except that the sole and bed plates are both 16x¾x24-in. and the expansion slots are 3 in. long. The bearings for the 50 ft. girders are the same except that the sole plates are 17x¾x24-in. and the bed plates are 19x¾x24-in.

The 60-ft. single track deck girders have ¾-in. sole plates the exact width of the lower flanges, with 1/16-in. clearance between each planed edge and the guide ribs on the upper surfaces of the cast steel pedestals 8 in. high which increase the bearing area on the masonry nearly 140 per cent. above that of the sole plate. The girders are bolted to the pedestals by four 1-in. bolts and the pedestals each have four 1¼-in. rag bolts. The metal in the pedestals is 1 in. thick uniformly, and they have four transverse and three longitudinal vertical webs dividing the space under the sole plate into six 4½x5¾-in. cells, accessible through 3x3-in. holes in the centers of the transverse webs. The bearings for the single track deck girders 70 ft. long are like those for the 60-ft. girders except that the pedestal bases have their dimensions increased to 29 in. wide and 20 in. long and have their corners rounded.

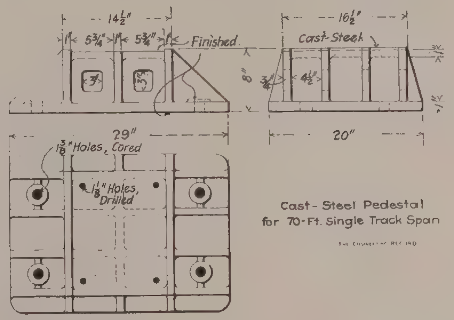
Standard single track deck girders, 80, 90 and 100 ft. long, have bearings which differ only in the dimensions. Shoes of very nearly the same width as the uniform bottom flange and of the same length and depth, but varying in the thicknesses of the materials and the sizes of the pinholes, are bolted, without sole plates, to the lower flange angles of the girders. They have three webs with the connecting angles of the outer ones turned inwards, and are made with full pin bearings on the web angles which reach to the center line of the pin. The pin bearings are half holes except in the outside web plates, which have full holes. The roller end pedestals correspond to the shoes, reversed, except that the connection angles for the outer webs have their flanges turned outwards and the base plate projects several inches beyond them to engage the anchor bolts clear of the angles. The webs are in the same vertical planes in shoes and pedestals, so that the pin bearing is reduced to direct compression and shear and bending are eliminated. The outside web plates are riveted on opposite sides of their connection angles so as to match past each other, and are locked together by the pin with shouldered ends and chambered nuts. The inclined edges of all web plates are connected by cover plates, which completely enclose the interior of the shoe and pedestal so as to exclude rubbish. At the expansion end the base plate of the pedestal is seated on five cast steel segmental rollers, and has riveted to it a center longitudinal rib to engage a corresponding groove in them. The sides of the rollers are hollowed and their ends are tap-bolted top and bottom, to side plates arranged with end stops to lock them and prevent the rollers from having an angular displacement greater than the allowed maximum. The rollers are seated on a bed made with two rolled plates riveted together and having a slightly larger area than the pedestal base. Four 1¼-in. rag bolts pass through 1⅜-in. round holes in the bed plate and 2x3-in. slotted holes in the pedestal base plate. Between the bed plate and pedestal the anchor bolts have pipe separators.

The fixed end pedestals correspond to the expansion end pedestals except that the base-plate forms the top cover plate of a bolster of a height to compensate for the rollers and maintain both ends of the girder at the same height above the masonry seats. The bolster is made with five longitudinal webs, each composed of two 7-in. channels, back to back, riveted to a pair of bottom plates slightly larger than the top plate. Short vertical angles with their flanges turned in opposite directions are riveted to the channel webs on the center line and their outstanding flanges are riveted together to form a transverse diaphragm bracing all webs. The four anchor bolts pass through the bolster and their nuts take bearing on the pedestal base plate.

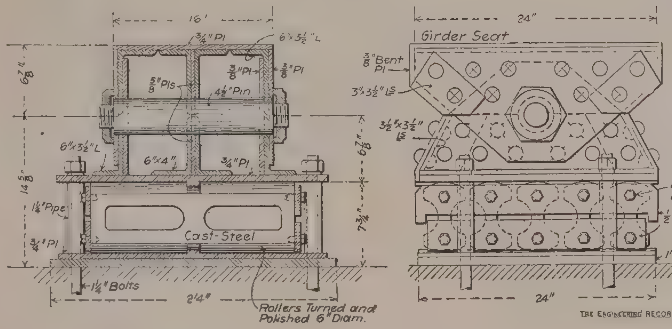
Double-track through plate girders from 35 to 50 ft. long have sole plates riveted to their



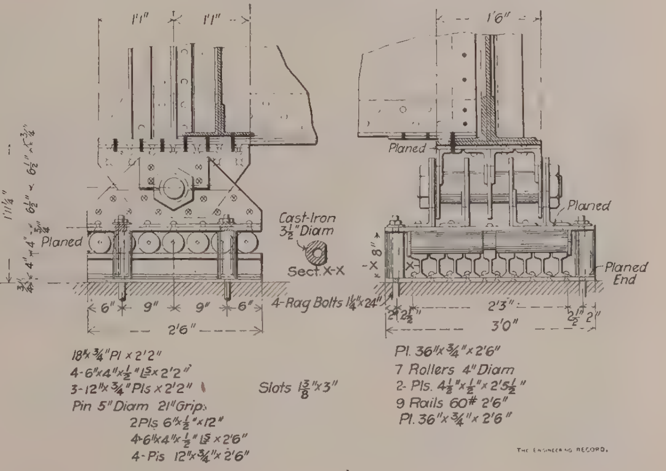
Bearing for Fixed End of 80-Foot Deck Span



Cast-Steel Pedestal for 70-Ft. Single Track Span



Expansion Bearing for 80-Foot Deck Span



Expansion Bearing for 95-Ft. Span.

Fixed and Expansion Girder Bearings, Union Pacific Railroad.

lower flanges and seated on cast iron pedestals similar to those described for the short span deck girders except that they have only two transverse and three longitudinal webs and have no guide ribs projecting above the tops of their cap plates.

Through double-track girders 65 to 95 ft. long have pin bearings with fixed and rolling pedestals. The shoes and pedestals are similar to those for the deck girders except that all their webs have full holes for the pins and that the pedestal has four webs alternated with those of the shoe so that the pin is subjected to bending stresses. At the expansion end the shoes are seated on nests of full-cylinder rollers connected by tap bolts with side strips planed on the upper edge to fit closely against the under surface of the pedestal base plate and having the lower edge project below the top of the roller bed, thus forming a dust guard to protect the roller surfaces. The roller bed is made with longitudinal track rails having their heads planed horizontal for roller bearings and having one side of each head and flange partly cut off, so that they can be seated closer together on the base plate to which they are riveted. The longitudinal edges of the base plates of both the roller bed and the pedestal project several inches beyond the ends of the rollers in order to receive the four anchor bolts which pass through vertical cast iron sleeves having both ends planed square for bearing against the opposite surfaces of the plates. At the fixed end of the span the rollers and their beds are omitted, and in their place there are cellular cast iron bolsters made of metal 1¼ in. thick, planed top and bottom.

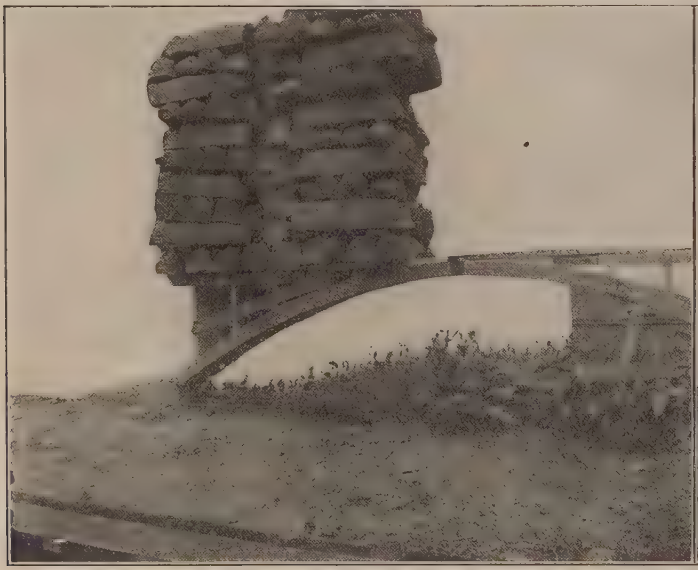
(To be continued.)

The Tests of a Steam Boiler of the Yarrow type, in the "Warrior" of the British Navy, were reported recently in "Engineering." It had 3,163 sq. ft. of heating surface and 53.35 sq. ft. of grate surface. With a combustion of 24 lb. of coal per square foot of grate per hour, an equivalent evaporation, from and at 212°, of 11.66 lb. per pound of coal or 4.72 lb. per square foot of heating surface per hour was obtained; with the rate of combustion at 36 lb. per square foot of grate per hour, the evaporation was 10.97 lb. per pound of coal and 6.65 lb. per square foot of heating surface; with the rate of combustion at 48 lb., the evaporation was 11.04 lb. per pound of coal and 8.93 pound per square foot of heating surface per hour.

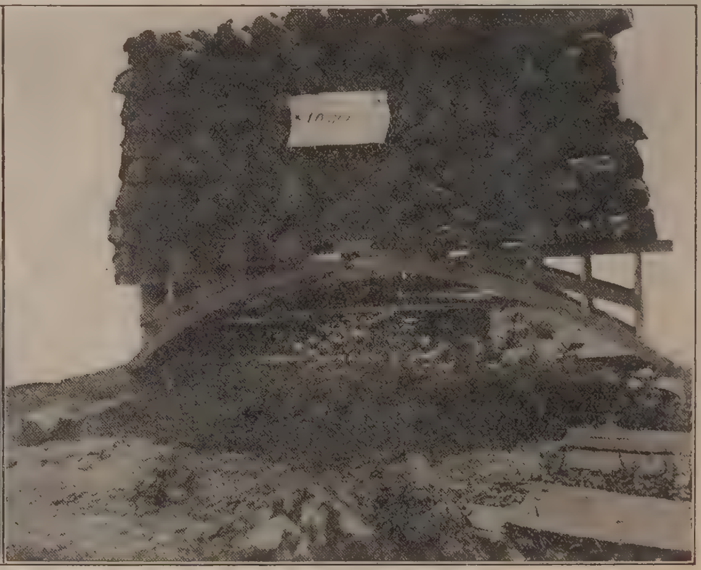
A Three-Hinged Concrete Steel Arch.

A paper read before the Ohio Engineering Society by L. A. Keith, City Engineer, of Mansfield, O.

So long as natural stone was the only available building material for the masonry arch, the introduction of hinges, except in a rudimentary form (sheet lead joints) was not feasible on account of the massive nature of the construction required, but with the advent of a plastic and reliable artificial stone, capable of a tensile reinforcement, a material was at hand that opened the way to a light, elastic form of arch rib, economical in construction, and of a type suitable for hinge insertion. The reactions of a three-hinge arch being wholly determinate statically, and temperature stresses as well as horizontal or vertical displacements of considerable extent in the abutment being negligible, a lightness in the construction is made possible which would not be warranted in other types of arch, subject to a number of more or less uncertain elements in their design. If the transmission of the live load to the arch rib be made through vertical walls parallel to the hinge lines, their points of application and direction are known, and the equilibrium curves or polygons for any loading may be deduced with certainty.



Model with Concentrated Load.



Model with Uniform Load.

These facts and conditions were suggestive of many interesting possibilities and induced me to initiate on a small scale what I hoped would be practical on a larger. A model was built with a span of 96 in. and rise of 17 in., with the vertical axis made coincident with a parabolic curve passing through the centers of the hinges. The area of normal sections of the arch rib, taken at the crown and abutments were equal, and measured 1⅞ in. in depth by 12 in. in width (22.5 sq. in.). This depth increased uniformly towards the quarter points to a maximum of 2½ in., the width remaining constant, making cross-sectional areas at these points of 30 sq. in.

A reinforcement of ¼ in. square iron bars was distributed through the upper and lower sides of the rib, three above and three below the axis, with their centers ½ in. from the surface.

Vertical struts in lines parallel to the hinges and at points distant 4.3, 11.8, 19.3, 26.8, 34.3, 43, 53, 61.7, 69.2, 76.7, 84.2 and 91.7 in. from the left hinge center and called herein for convenience, load points 12, 11, 10, etc., respectively, transferred the live loads to the rib.

Two castings of iron, alike in size and having flat bearing plates connected with babbitt bushed and semi-circular hubs by a series of vertical web plates and a ⅝-in. steel shaft, constituted the essential elements of the hinge.

The bearing plates were of a size to cover the normal end sections of the rib (1⅞x12 in.) and the hubs a trifle less than one-half of the shaft. When assembled into the work, the castings lay on opposite sides of and with the bushed hubs embracing the shaft, and with the bearing plates normally inclined to the axis of the arch.

Under a uniformally distributed load of 10,000 lb., equivalent to 1,250 lb. per square foot of horizontal projection of the arch rib, the hinge end of the abutments settled, the one 0.7 in. and the other 0.4 in., and the rear ends about 0.3 in. and 0.2 in., respectively, within ten days. A normal thrust was developed on the bearing plate of the hinge of 270 lb. per square inch, and on the shaft 1,330 lb. per square inch of projected bearing surface (length of shaft times its diameter), with a maximum vertical shear in the castings of the hinge of 200 lb., and in the concrete 190 lb. per square inch.

This loading was followed by gradually increased and uniform load concentrations on load points 12, 11, 10, 9 and 8, until with a total live load of 6,200 lb. sudden rupture of the rib occurred immediately to the left of load point 12, that is between the abutment hinge and the first load, the line of fracture inclining somewhat from the normal at that point, towards the vertical, through the same point.

Failure was due to a slipping of the reinforcement either preceding or following the formation of a crack in the tension side of the rib. With a perfectly elastic rib body, the rate of transference of stress to the reinforcement at any point would be in proportion approximately to the rate of change of the bending moments, and since the rate of change of the latter is a maximum with the above loading in the end sections, that is, in the section between the abutment hinge and the first loading point, failure in such point and manner could be anticipated without the preliminary cracking of the concrete, unless proper mechanical provisions were adopted, at such points to prevent slipping.

Normal sections crossed by the line of fracture were subject to bending moments of 10,500 in.-lb. with a perpendicular thrust of 5,830 lb.

While the maximum unit stresses prevailing therein are indeterminate without certain problematical assumptions, limiting conditions of some value can be deduced. Considerably larger moments existed in other parts of the rib, approaching a maximum of 28,000 in.-lb. in sections through the quarters. A crack showed between load points 8 and 9, with load concentrations increased to 873 lb. each (bending moment, 19,500 in.-lb.).

The hinges gave no indications of weakness at any time, so far as I could observe. Portland cement concrete was used (1:2:4) in the rib. Tests were made 28 days after completion.

With these results in view a modified design was formulated, resulting in the recent construction in this city (Mansfield, Ohio) of an arch of 40 ft. span, 7½ ft. rise, 40 ft. width and suitable for ordinary street traffic.

Three-Hinged Concrete Arch Constructed at Mansfield.

The thickness of the arch rib varies from 10 in. at the abutments to 12 in. on the quarters and to 8 in. at the crown. Light vertical concrete walks, parallel with the hinge lines and spaced about 3 ft., center to center, support the reinforced concrete floor. The neutral axis coincides with the dead load equilibrium curve.

The hinge castings are of good quality iron, patterned closely after those of the model, and made in 2-ft. sections for convenience in handling and to provide for any unequal expansion and contraction between the concrete and bearing plates.

With the abutments completed and centering in place, the component parts of the hinges were assembled on the work, the castings being brought into position about a brass-covered shaft, 2 in. in diameter, with their bushed hubs seated thereon and each pair secured in place by U-shaped round iron hooks passed about the hub of the one and with their threaded ends pushed through holes in the bearing plate of the other. By turning down nuts on these ends against the bearing plate, an intimate contact was developed betwen the shaft and its seat, equivalent to that produced by the load of the arch itself.

After alignment, the spaces betwen the abutments and bearing plates were flushed full of a rich cement mortar, and the construction of the arch rib itself proceeded with.

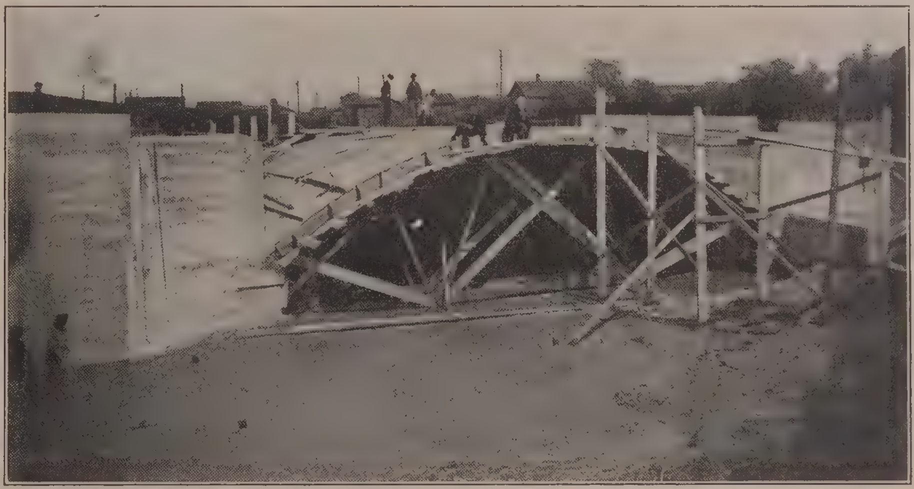
The rib is of monolithic structure, each section constituting one day's work and extending from the bearing plates of the abutment hinges to those at the crown, being carried up on both sides at the same time.

The striking of the centers after a period of 14 days was followed by a deflection at the crown of 0.035 ft., which was not further increased by the later additions of the superstructure composed of lateral walk, floor, etc. A change in temperature recently of 50° caused a deflection of 0.05 ft.

While the abutments rest on a foundation of gravel and blue clay of moderate consistency, no horizontal or vertical displacements have occurred.

A loose concrete slab or plate covers the crown hinge and makes a continuous floor or roadway.

The total cubical contents of the concrete in the arch rib and abutments for a section of one foot in width, amounts to 4½ cu. yd., 1¼ cu. yd. in the former and 3¼ cu. yd. in the latter. The total weight of the hinges per lineal foot of width equals 240 lb.



Centers for Three-Hinged Arch at Mansfield.

While the dead loads produce no flexural stress in the rib and a uniform live load but little, owing to the near coincidence of the curve of its axis to that of a parabola, heavy concentrated live loads cause bending moments of some extent, and require consideration similar to that of a steel arch with solid web.

Moving live loads such as would be produced by the passage of a standard type electric car, will develop maximum bending moments in the quarter points equivalent to 65,000 in.-lb. per foot of width and 26,600 in.-lb. in the sections between the abutment hinges and first load points, with a maximum tensile stress of about 140 lb. and vertical shear of 30 lb. per square inch in the concrete in the former and 30 lb. tension and 50 lb. shear in the latter.

The total shearing stress in the castings of the hinge, for such loading, equals 400 lb. per square inch; the thrust per square inch on bearing plates 130 lb., and on the shaft per lineal inch of length 1,000 lb. The horizontal component of the dead load thrust is 6,750 lb. per foot of width of arch.

The arch rib is built of 1:2:4 concrete, with reinforcement in the nature of plain bars with sectional area of from 0.7 to 1 per cent. of the cross-sections.

The three-hinged concrete arch presents some very desirable features aside from the question of cost. The fact that the reactions are statically determinate, renders the determination of the equilibrium curves for various loadings a matter of ease and certainty and with the removal of temperature and other stresses, due to possible horizontal or vertical displacement of unknown extent in the abutments, lends confidence in the use of higher working stresses than would otherwise be warranted. A less massive construction follows, resulting in lighter centering, lessened thrust and decreased weight to be supported by the foundations, factors of great importance in the majority of instances where arch construction is considered.

Some Phases of Sewage Disposal.

Extracts from a paper read before the Ohio Society of Engineers, by Mr. F. A. Barbour, M. Am. Soc. C. E.

The use of the septic process is not always a success. This depends on the design of the tanks, but principally on the quality of the sewage. If the sewage is strictly domestic, then the percentage of solid matter which can be liquefied should be large enough to justify the adoption of the process. In the experience of the writer, septic treatment has been a pronounced success at a number of places, among these at Saratoga, N. Y., where tanks of 1,000,000 gal. capacity have been in operation since July, 1903. (See Eng. Record, Jan. 21, 1905.) Systematic analyses of the sewage and effluent and gaugings of the scum and deposit have been taken since the commencement of operation. At the present time there is less accumulated matter than there was one year ago. Sixty-five per cent. of the suspended solids have been removed from the sewage, 75 per cent. of which has disappeared by liquefaction. This has greatly reduced the work of keeping the surface of the filters clean and so lessened the cost of maintenance.

The necessary factors to success in septic treatment are the division of the total capacity into units, so that the time of exposure can be adapted to the quality of the sewage, the provision of an inlet and outlet which will make effective the entire cross-section of the tank, and the use of a depth which will permit the seasonal variation in the quantity of accumulated scum and deposit without putting the tank out of commission.

The efficiency of the process is most intimately dependent on temperature. In winter the solids will greatly increase, but will disappear with the rising summer temperature. At Saratoga the scum and deposit occupied 40 per cent. of the entire volume of the tank in March, when the temperature was at 41° Fahr., but in August, with the temperature at 70° Fahr., this accumulation had been reduced to 21 per cent. The necessity for a depth which will permit this seasonal variation is evident.

As to the desirability of covering the tanks opinions differ, but altogether, aside from the better appearance and lessened odor of the covered plant (and this, to the writer, is most important), it is well to roof the tanks wherever the winter temperature is such as to freeze the scum to any depth. The portion frozen is certainly not effective for the time being. At Saratoga the scum was frozen for a depth of several inches under the groined masonry roof and earth covering. What would have happened had the tanks been open may be imagined.

Strainers of various materials have unquestionable merit, but demand more constant and careful attention than the septic process. In large plants, where well-trained attendants are available, strainers can unquestionably be used to advantage, and it is probable that in the future we will see for large cities highly organized plants in which sectional strainers and rapid filters will be employed. It is well to remember, however, in considering any of these rapid methods, that the gain in rate and reduction in area usually means increased care in the maintenance of the plant, and from the experience of the writer, the average municipality has not yet been educated in sanitary work to the point where great intelligence can be safely anticipated.

The choice of a method of treatment will depend on local conditions. Generally the higher the purification, the greater the cost, and an economic design involves an appreciation of the necessary quality of the effluent. Sometimes settling or septic tanks alone will do, sometimes coarse strainers, again contact beds may answer, but if a very high degree of purification is necessary, slow sand filtration is the only feasible method. With the present knowledge of the art it may be said that where suitable sand can be economically obtained it should be used as the filtering medium. This is because the higher rate methods of contact beds and streaming filters require more expert and constant attention, and cannot turn out an effluent of the same purity.

Sand filters will, if the surface is kept clean and open, give an acceptable effluent at all times, and any lack of attention will result in only surface derangement which can be easily remedied. With suitable material the condition necessary for successful operation is the maintenance of the surface so as to permit the entrance of air sufficient to effect the purification of the sewage. In this connection it may be well to call attention to the necessity for aerating a septic effluent before applying it to the filters. Being devoid of oxygen, its avidity for this gas, if not satisfied before entering the filter, will lead to the reduction of that in the filter below the amount necessary for nitrification. Neglect of adequate aeration has probably been the reason of the difficulty sometimes encountered in purifying septic effluent.

Along the same line, to insure the presence of sufficient oxygen in the filters, is the necessity for intermittent application of the sewage in doses of such amounts and at such a rate as to effect thorough distribution of the sewage over the surface. In the opinion of the writer, nothing in filtration work is more important than the design of the distribution system, and more plants have partially failed because of neglect of this feature than for any other reason. Several types of automatic dosing apparatus have been devised which, with practically no attendance, shift the sewage from one bed to the next and discharge on each a dose of predetermined size.

The danger with contact beds lies in the clogging of the coarse material by solid matter below the surface where it cannot be removed by raking. Where used it is generally considered advisable to subject the sewage to some form of preliminary treatment to remove the greater portion of the suspended solids. At Mansfield, Ohio, one of the largest plants of this type has been successfully operated for several years. It consists of septic tanks of 1,000,000 gal. capacity and 1½ acres of cinder contact beds, by which the sewage from 12,000 people is satisfactorily purified.

Success in any method depends not only on the general scheme of purification, but also on the attention given to the design of the many details. A minute change here and there may make all the difference between success and failure, and when municipal authorities learn to appreciate this fact they will also recognize that the best results will not be obtained by competitive bidding for the engineering of such work and the giving of the design to a bidder with little experience and at a price for which he cannot afford to consider the problem properly and minutely.

Spray Nozzle for Air Purification.

Another danger at the present time is the lack of appreciation of the necessity for high-class supervision and maintenance of the plant after it is installed. If it were the practice for the designer to be retained to supervise the operation during the first year, many plants which turn out partial failures would be saved and much valuable information gained to the future benefit of the works and the profession in general. It is the lack of carefully collected data which is preventing the evolution of an exact science of sewage disposal. Experimental stations are of great value, but as the results there obtained are based on the treatment of one particular sewage, there is always danger in drawing general conclusions from them. It will only be by a gradual accumulation of exact data obtained in actual work under many different conditions that practical knowledge of the art will gradually become crystallized.

Five Tons of Refuse are said to be equal to 1 ton of coal in the Kettering, England, central electric station, where there is a two-cell Meldrum destructor.

Air Purification in the Ventilating Plant of the City Hall, St. Louis.

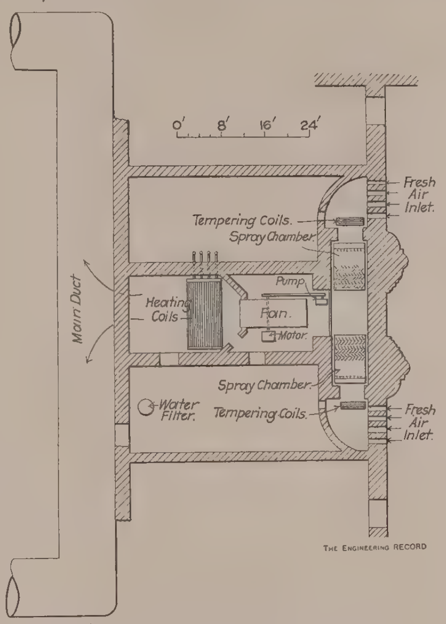
Some data on the operation of a water-spray filter installed something over a year ago in the heating and ventilating plant of the new city hall of St. Louis have recently been received. Here in common with similar fan systems of heating in cities of the soft-coal-burning class, much annoyance was formerly caused by dust and lighter particles of debris in the air being drawn into the fans and deposited in the building. The purifier in use is of the type developed by Mr. R. H. Thomas, of Chicago, and consists of a system of water-spraying nozzles distributed across the main air passage of each air system and of an eliminator, or system of baffles, for intercepting the dirt-laden moisture. Besides its office as an air cleanser, it is employed as a regulator of humidity and in warm weather as a means of cooling the air. It was provided under plans and specifications of Mr. J. W. Wood, chief engineer of the New City Hall, who found that his scheme in general was covered by the Thomas patents, and it was installed by Messrs. T. K. Peters & Co., as representatives of the Thomas & Smith Co., of Chicago. The work was done in connection with a lighting plant that was completed in July, 1903, for lighting both the new and old city halls and adjacent municipal buildings.

The building is warmed by the fan system of circulating heated air, with the exception of the lower main halls and corridors, which are heated by direct radiation. There is one fan with a 12-ft. blast wheel for the center of the building and a 10-ft. fan for each end. Each fan heater unit comprises tempering and heating steam coils, with the fan placed between, and the air washer is between fan and heater, in the case of the center unit, but between tempering coils and fan in the case of the other units.

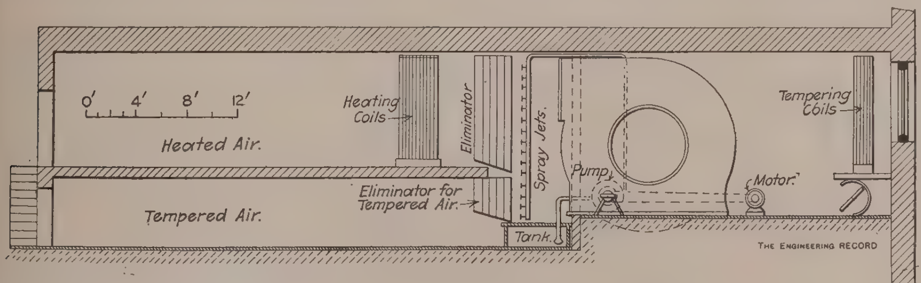
The fans are all of the centrifugal blower type, with top horizontal discharge, and were built by Buffalo Forge Co. Each is direct driven by a 220-volt Crocker-Wheeler motor, that for the larger fan being of 25 h.p., and those for the two smaller fans, of 20 h.p. The usual tempered air passage is provided underneath the main heater in each case and the temperature of the different rooms is regulated by means of the Powers apparatus for automatic temperature control, dampers actuated by compressed air supplied under the control of thermostats in the rooms, serving to mix, as desired, the tempered and heated air. At the normal speed the combined capacity of the three units is 211,000 cu. ft. of air per minute, but the fan motors are equipped with speed-regulating rheostats which allow a variation of 20 per cent. in speed. The total radiation in the building approximates 76,000 lin. ft. of 1-in. pipe, and the steam is circulated with the assistance of the Paul system of air removal from coils and radiators.

The spraying apparatus in each case consists of an overhead horizontal pipe, a number of branch pipes dropping from it, and spraying nozzles tapped into each of the drop pipes. The drop pipes are tapped into the horizontal main alternately on opposite sides, those on the same side on about 17-in. centers, and those on the opposite side on the same distances but midway between. Each drop pipe carries four nozzles, likewise about 17 in. apart, but the nozzles on one pipe are staggered with respect to those on the next pipe, so that, looking in the direction of air flow, the entire cross-section is furnished with spray nozzles in crossing diagonal lines with the nozzles on these lines 12 in. apart. Each drop pipe is 1 in. in diameter on leaving the main, is ¾ in. after leaving the first nozzle, ½ in. beyond the second and ⅜ in. to the last nozzle.

There is one spraying chamber for the center fan-heater unit, but two for each of the end units, the latter having each two air inlets, two tempering coils and two air washers. In each case the sprays are supported over a water storage and settling tank and to this is also drained the water caught in the eliminators, the latter having a floor sloped to the tank for this purpose. This tank is built of No. 14 galvanized iron, with a 2-in. angle iron frame around the top edge, and is 18 in. deep, about 5 ft. in the direction of the air flow and wide enough to extend across the spray chamber. The two washers on each of the end units are supplied with water from a Gould centrifugal pump, this having a 3½-in. suction and a 3-in. delivery; and the washer of the center unit is supplied by a similar pump having 4-in. suction and 3½-in. delivery. Each pump is driven by belt from the shaft of the adjacent fan. On the suction pipe in each tank is a brass screen having an area equal to ten times that of the suction pipe. On the fresh water supply is an automatic ball cock which is arranged to maintain a uniform water level, while from a point 2½ in. from the top of the tank is an overflow of twice the area of the delivery-pipe, run to the nearest sewer connection. The baffles of the eliminator are made of No. 18 galvanized iron, placed in rows six deep in the direction of air flow, and the eliminator and chambers are enclosed in casings of No. 18 iron, stiffened with 1½-in. angles, except the sloping bottom of the eliminators which is of No. 16 iron with 2-in. angles. The galvanized-iron work, which includes the piping, was all painted with two coats of Galvanum, the galvanized-iron paint manufactured by the Goheen Manufacturing Co. Though six rows of baffle plates were specified, it was a point about which no definite information appeared available, and in operation it is stated that the moisture never gets beyond the third row, so that four would probably have been sufficient.



Arrangement of End Heating Chambers.



Vertical Section through Central Heating Chamber.

There are 32 spraying nozzles in each chamber of the end units and 92 in the spraying chamber of the unit in the center of the plant. The nozzles, a view of one of which is shown herewith, are of brass. Against the orifice of the nozzle is held a brass spoon mounted on a thimble by which it may be fastened as near the orifice as desirable. The handle of the spoon is provided with a hole so that a series of the spoons may all be strung upon a small rod and all may be revolved away from the orifice at any time. This provision has not yet proved a necessity. About once a week the bottom head of each riser becomes filled with light material such as straw. The water is supplied to the nozzles by the pumps at 5 lb. pressure.

The washers were installed under a guarantee that all the air delivered through the apparatus into the building would be freed of 96 per cent. of all dust and foreign matter contained therein, and that an average percentage of humidity of 70 per cent. would be maintained, with variations of 3 per cent. in extreme hot weather. It was further guaranteed that in summer, when the apparatus is in service, the temperature of the air passing through it should be reduced to within 4° of the temperature of the water, so that, if, for example, the water was 60°, the air after passage through the washer would be 64°. It is intended that when the air is recirculated in the building during extremely cold weather or during other times when it may be desirable to maintain an internal circulation, that the air will be restored to a healthful condition by its pasage through the washers.

A test of the system was carried out Mar. 3, of last year, and the results, contributed by Mr. Wood, were as follows, the humidity being determined by the use of wet and dry-bulb thermometers: In unit No. 1, which is one of the end outfits, the humidity before washing, between the tempering coils and the washers, was 11 per cent., and after washing, 50 per cent.—the corresponding figures for the other end unit were 27 and 42 per cent., respectively; and the figures for the center unit, No. 2, were 21 and 66 per cent. A test as to the efficacy of the apparatus was also made by stretching a clean white sheet across the path of the air after it had left the washer, and a bucket of soot was thrown into the air in the washing chamber; the sheet test was of 6 hr. duration, and the sheet showed the slightest coloring at each corner. It was agreed that the air was 98 per cent. clean. Before putting in the washers the air was tempered to 60° but now the limit is 40° to 50°, in order to carry less moisture into the building, as better results, it is stated, are thereby obtained. As it is tempered air that is passed through the washers, regulation of the temperature of the tempered air provides for regulating the humidity in the rooms. By means of the temperature regulating dampers the same room temperatures are maintained regardless, within limits, of the temperature of the tempered air. The water in the tanks under the washers is changed every 24 hr., but in 2 hr., it "is like ink."

The electric lighting plant installed in the building and from which current is obtained for the fan motors, is, in brief, made up of the following machinery and apparatus: The boiler plant consists of four 275-h.p. Heine water-tube boilers, with Hawley down-draft furnaces, operated at 110 and 120 lb. steam pressure. The engines were furnished by the Chuse Engine Co., and consist of three four-ported engines of the self-oiling type with 17x16-in. cylinders and 260 r.p.m. operating speed, and one 14x14-in. engine. Each of the larger machines drives two direct-connected electric generators, one a 60-kw. direct-current generator and the other a 50-kw. alternating-current machine. The small engine is direct connected to a 75-kw. direct current generator. The engines are operated non-condensing, so that their exhaust is utilized for heating. The voltage on both styles of generator is 220 volts, and the alternating current is transformed to 2,100 volts for transmission to the outside buildings, where it is reduced to 110 volts for use. Balancing sets are employed with the direct-current dynamos to equalize the pressure on the three-wire system of distribution on which the lighting in the city hall is supplied. The electric machinery is of the Westinghouse manufacture. All engines have the Manzell automatic direct-connected oil pumps for cylinder lubrication in addition to a gravity system from a central tank. There are two 10x5x10-in. Worthington outside-packed plunger duplex feed pumps, receiving their supply from a feed-water heater. A small Worthington duplex pump serves for circulating hot water for the house supply and there is a Burnham 6x8x8-in. air compressor for the temperature regulating system and for cleaning in the plant.

Crushing Strength of Hollow Tile.

The crushing strength of hollow tile has been tested by Mr. E. V. Johnson, vice-president and western manager of the National Fire Proofing Co. The test was made on a pillar 3 ft. 0¼ in. long, 3½ in. wide and 10 ft. 2½ in. high, built of hollow porous, Hobart partition tile taken at random from stock. The blocks had walls 11-16 in. thick and were laid up, with the hollow parts vertical, in lime mortar to which a little cement was added. Three surfaces of the pillar were plumb. The pillar was plastered with a mortar of 1 part of Portland cement and 2 parts of screened sand. It carried loads without appreciable injury until 60 tons were reached, when a serious cracking sound was heard. A slight sound was also heard at 78 tons. At 90 tons cracks appeared at the top and the pillar failed by the breaking of the inner webs. There was also a tendency of the plaster to leave the walls. There was no buckling at any time. The odd-numbered courses, beginning at the bottom, consisted of three whole blocks, while the even numbered courses consisted of two whole and two half blocks. The unit load at failure was 1,687 lb. per square inch.

Corrosion Tests of Boiler Tubes by forcing air through tubes wetted by distilled water showed a loss in weight in sixteen weeks of 0.315 g. per square inch, while when the water was made alkaline the loss was reduced to 0.1 g.

Steam Power for Electric Railways.

A paper read before the Ohio Interurban Railway Association by E. P. Roberts.

In taking up the matter of steam power, it is evidently necessary to consider, first, what is needed, and second, what is best for the conditions. I will follow this logical order, therefore, and although, at the start, the reason for the first may not be apparent, I think it will be before the completion of the presentation of the second. As this audience is mainly composed of men interested in the operating and financial, rather than the technical end, my talk will not be relative to technical features from the technical standpoint, but from the standpoint of the effect of modifications of such features upon financial results.

In Ohio, the prime mover is usually a reciprocating steam engine, although, in a few instances, a steam turbine is used. In some portions of the United States water-power is being largely utilized as the prime mover, but there are few, if any, economically desirable properties of such kind available in Ohio. Owing, however, to the recent developments in the line of gas and oil engines, there are situations where these engines should receive consideration.

To decide what prime mover is best for a specific case, considering type, number of units and size of each, all the factors affecting the case must be considered, and, generally speaking, in the following order:

First—Predetermination of the operating conditions.

Second—Estimate of first cost.

Third—Estimate of operating expenses, including financial charges.

Fourth—Comparative reliability, depreciation and repair account, and other matters which are largely questions of judgment.

Fifth—Combination of all the above, considered for each type of power plant, and a comparison of the results.

This necessitates a decision as to the location of the track, and the curves and grades most economically desirable, and the predetermination includes the following:

A certain location of the road is taken as the standard for comparison, being generally that which will give excellent, though not necessarily the greatest, accessibility on the part of the public, and having such grades and curves as a general knowledge of the proposition indicates would be good practice. The size of cars and number of trains necessary to handle the anticipated passenger travel is decided, and train schedules and train sheets are prepared which show the schedule time between the terminal points, based on a stated average schedule speed in the cities and towns, and a stated average speed while the car is in motion in the country, with deduction from the latter on account of country stops, thereby obtaining the schedule speed in the country. The train sheet shows the trains in service at any moment and the location of such trains. The size of motors necessary to handle a car or train of the assured weight and speed is then calculated.

A study of the results as above obtained may indicate that it is preferable to employ a slightly greater schedule speed between the terminal points, so that, when operating on an hourly headway, the layover at the end be not too long. For example: The time of the tentative run may be two hours and ten minutes, which would necessitate a layover of twenty minutes when the cars are operated on hourly headway (starting from one end on the hour and from the other on the half-hour). This would require five cars in operation, whereas if the cars could make their run in one hour and fifty-five minutes, only four cars would be needed. Such a reduction in the number of cars would reduce the expense of the train crews 20 per cent., and the greater schedule speed between termini would be attractive to the traveling public.

To accomplish such higher schedule speed, one or more of the following factors must be changed:

(1) Higher schedule speed in the cities and towns. This may not be practicable.

(2) Higher speed when in motion in the country. This would require larger motors and greater rapidity of acceleration, which would increase the first cost, not only of the rolling stock, but also of the entire power generation and distribution system, and it is the resulting increase in maximum and average power requirements which to-day especially interests us.

(3) Reduction in number of country stops. This may reduce the income, and whether it is advisable depends largely upon the character of the proposition, and also whether or not "limited" trains will be operated. Consideration must also be given to the time made by competitors, more especially between distant points.

(4) Change of location in the road so as to shorten the distance. This may necessitate giving lessened facilities to some localities, or may necessitate more expensive construction, or both.

(5) Such change of location as will allow higher schedule speed. This may be done by reducing the lengths of the runs on streets, or if the right of way is by the side of the highway and in front of buildings, changing same so that it is back of the buildings. Sometimes the best location is adjacent to a steam road.

(6) Reducing grades and curves.

Consideration of the above factors, individually and collectively, also necessitates consideration of comparative first cost and operating expense, and comparative gross and net income, and the study of all the conditions may result in a decision to operate at a slower schedule speed, and change one or more of the above factors in the opposite direction from that required to increase the schedule speed. If "limited" trains are to be operated this fact must also be considered.

The above relates to passenger service, but, in addition, express and baggage service may require consideration, as may also freight, using this word to mean the same as when applied to steam roads.

A specialist in the predetermination of what is the most desirable construction and equipment for any given proposition, may not, and possibly will not, work out in detail and with all possible modifications all these factors, but he will consider them, even though, to some degree, it may be unconsciously. The results obtained are frequently a surprise even to those who make it their business and who might be supposed to be able to state "off hand" what would be most desirable for any given proposition.

A striking proof of the lessening of the amount of power required, obtained by increased care in design, is shown by a statement made by A. S. Richey, in a paper read by him before the Indiana Electric Railway Association, Jan. 12, 1905, in which he states that the same cars are used on the northern division of the Indiana Union Traction Co. as on the other divisions, and power is furnished for the entire system from one power house; that the average distance of the substations on the northern division is 46 miles from the generators, and on the others 15 miles; also that 12 per cent. of the power used on the other divisions is delivered directly from the power station without a. c. transformer or transmission losses. Nevertheless, the power for the northern division, measured at the power house, is only 33 per cent. of the total, although it represents 42 per cent. of the total car mileage. He also states that the average schedule speed is slightly greater on the northern division than on the balance, and that the result illustrates: "The general effect of a careful consideration of operating features in the engineering design and construction of a road, such as reducing curves and grades to a practical minimum, careful location of sub-stations with respect to their loads, and the economical distribution of copper."

The subject of this talk being "Steam Power," it may seem as though I had wandered far from the path, but all the parts of an electric road are so interconnected, financially and physically, that a proper decision as to steam power mechanisms can only be made after a study of the entire proposition, and in more or less detail depending upon its special features. For example: If power is very expensive, measured at the motors on the car, then, from this standpoint, a reduction of grades is economically advisable, as well as a reduction in the size, number and speed of cars; whereas, if power is cheap, the reverse is preferable.

All these factors are so interconnected that, in order to obtain the best plan for the given conditions, a tentative plan must first be prepared which will be in accordance with the engineer's best judgment, based upon a preliminary study of the general and special conditions, and then such plan must be modified and the effect of such modifications considered from every standpoint—first cost, operating expense and effect on gross and net income.

It is therefore evident that the decision as to the power plant necessitates predetermination, within a reasonably close limit, of the average output which will be required at different hours of the normal operating day and the maximum which may be required for any considerable period, and also the momentary maximum, the excess being taken care of by the momentum of the fly-wheel. It also necessitates a decision as to similar features on days other than normal, for example: Saturdays, Sundays, holidays, etc.

It may seem that the above is what is frequently termed "not practical," or, looking at it from another standpoint, that it is "impracticable," and for the reason that operating conditions vary so greatly from day to day that it might be considered impossible to predetermine all of them with such degree of approximate accuracy as to obtain results of any value. There is not now time for elaborate presentation of proof that careful and skilled predetermination of operating conditions pays, and, in fact, pays better than an equal amount expended in any other manner. I will merely present as an interesting example the comparative results obtained by two power houses, each using the same make of water-tube boilers, stokers and compound condensing engines, and the one containing the poorer results having generators of one of the best makes, and the other having old style Siemens & Halske generators, which were probably somewhat less efficient than the other. The generators were direct connected, and both plants furnished direct current and used the same quality of coal at the same cost per ton.

The plant obtaining the poorer results did not have the conditions predetermined, and the result was that the various units were not of the best proportion for their operating conditions, considered as a whole and in relation to each other. In the other case the character of the output was predetermined and the sizes of units considered with reference to each other, and although the load for this power house was more fluctuating than for the other, the coal and the cost per kilowatt-hour output was materially less.

On the other hand, there is, of course, a difference between what may be termed calculations for commercial purposes and those made for scientific reasons. The basis of the former is generally only approximate and that of the latter is presumably exact, and it is evidently absurd to carry out calculations into fractions of 1 per cent. when the basis is not known within 5 per cent., or, to use a mathematical simile, to "use eight-place logarithms on four-place data."

Having predetermined the average maximum power required from the engine, or engines, when operating on regular schedule, and also for special days, a tentative decision is made as to the number of units and the size of each, based on capacity.

The condition of operation of engines furnishing power to an interurban electric road is, except when storage batteries are used, one of rapid and excessive fluctuations of load, usually ranging from 25 per cent. to 125 per cent. of the rated capacity of the engine, and often from 0 per cent. to 150 per cent., and sometimes momentarily up to 200 per cent.

I present the following as statements of facts:

For any engine supplied with steam at a definite pressure and quality and with a definite vacuum, there is a definite load at which it will operate at its greatest economy. Increasing the steam pressure, or superheating the steam, or increasing the vacuum will increase the maximum obtainable horse-power and, generally speaking and within limitations, the efficiency of the engine as a converter of heat energy into mechanical energy, but, considering the increased energy required by the engine auxiliaries, it will not necessarily increase the heat-energy efficiency, considered as a whole, and, even more important, it may even decrease the "dollar efficiency." The latter efficiency includes first cost and operating expense, and it is upon this efficiency, considering the entire road, that either dividends or assessments are declared.

We will now consider a few curves:

One of these shows the variation of coal per kilowatt-hour with a varying load factor in a certain station. This curve is based on the daily records obtained during one year. The power house is the Avon Beach power house of the Lake Shore Electric. The results are old and were published several years ago, and I would apologize for presenting old material if it were not for the fact that I have not results from any plant in which the coal has been weighed daily for such a long period and under such variation of percentage of rated load. It should also be noted that at rated load the test showed 3.2 lb. per kilowatt-hour, which, for this station, may be considered as the theoretical limit. It should also be noted that a change of proportion of the individual mechanisms and of the size of such mechanisms relative to each other could have been so made as to have obtained better results at rated load of the generator, but inferior economic results under the average operating conditions.

The next shows the effect of grades on the fluctuating demand for power and the effect of a schedule requiring the simultaneous climbing of grades by several cars. In this connection it might be noted that a schedule which will allow climbing of grades with motors "in series" is much better for the power house than one which requires "hustle" from start to finish; but, of course, this is not the only standpoint, and there are too many interconnected factors now to follow up this train of thought.

Other curves are presented showing the probable approximate amount of water per indicated horse-power for various types of engines and at various loads, and similar curves for boiler horse-power.

The curves presented are old and should be considered only on account of their general features and not for the specific values shown. Nevertheless, they admirably illustrate the points to which I desire to call especial attention, which are:

(1) Comparative water consumption on rating is not the proper basis for decision when operating on variable load.

(2) Comparative values obtained by comparing results for indicated horse-power are not the same as for boiler horse-power.

The statement has already been made that engines for interurban electric railways normally operate with loads varying from friction load to 100 per cent. overload, but it should also be noted that the average load is generally, and practically always, below rating. Because of this, it follows that an engine should be mechanically designed so as to carry with safety excess loads, and, from the steam standpoint, so designed as to give maximum economy at a point below that which is ordinarily considered as its rating. The valve operating mechanism should permit the entrance of steam for as large a percentage of the stroke as is practicable, and the steam passages should be of as great cross-section and freedom from bends as practicable in order that the steam may flow with the minimum drop in pressure. The cylinder, or cylinders, should not be any larger than necessary to give the required maximum of sustained power under the assumed conditions of steam pressure and quality, and of vacuum, including allowance for lessened pressure and vacuum when having a sustained load which is in excess of the normal.

Please note that I have here used the term "load in excess of the term normal." The common and more convenient term is "overload," but the latter term tends to convey the impression that the load is greater than that for which the apparatus is designed and that such load is injurious, which, for the case considered, is not only erroneous, but directly contrary to the fact.

What cylinder proportions, for any given case, are most desirable depends upon steam pressure, vacuum, etc., as well as ratio of average to minimum load, and in a paper presented by me at the New York meeting (December, 1903) of the Engine Builders' Association of the United States, I especially referred to the question of ratio of cylinder, diameters of compound condensing engine under variable load, and the advisability of reduction of such ratio as the percentage of maximum to average increases.

Evidently, for any given proposition, it is necessary to ascertain what will be the water consumption of the various engines it is desired to consider, and not only at rated load, but over a large range of load. This information for any given engine must be obtained from the manufacturer, but, unfortunately, statements sometimes made require investigation before being accepted.

Some engine builders know what the engine on which they submit a bid will do at rating and with stated steam pressure, quality of steam and vacuum. Fewer know the result which will be obtained at fractional loads. The engine builder does not know what will be the degree of variability of the load, nor the average load; it is his duty to furnish a certain mechanism to accomplish certain agreed upon results, but whether the operating conditions will allow such results to be obtained in practice he does not, and generally cannot, know. The actual result is often unfair to the builder and uneconomical for the purchaser.

As an example of the unreliability of data in bids, I present the following, which are taken from bids in our office:

Our specifications stated the steam pressure and quality of steam to be delivered at the engine throttle, the vacuum at engine exhaust, revolutions per minute, desired average indicated horse-power (i.h.p.), desired lower limit of maximum sustained horse-power at stated steam pressure and vacuum (slightly less than specified for the average), and specified a maximum limit for the piston speed, and a maximum and minimum ratio of diameters of high to low-pressure cylinders. Fifteen manufacturers were invited to render bids, and there was considerable difference in stroke, cylinder diameters, etc., and a comparison of all brought to the same basis necessitates too complicated calculations and too many considerations to present to a non-technical audience. I have therefore merely chosen data from the bids from four Corliss engine builders, of better than the average standing, each of whom happened to choose the same diameters of cylinders and length of stroke, therefore making the steam conditions the same for all except as modified by steam passages, clearance and control of steam by the valves. The comparison of all the bids showed differences far in excess of those here presented:

Bidders' Statements.

Point of maximum cut-off of steam.	Maximum sustained horse-power which I present as a percentage of the greatest.
0.75	79
.75	84
.75	72
.60	100

The lowest was approximately the limit stated in our specifications.

There might be a slight difference in the maximum horse-power obtainable, but that the engine having a maximum cut-off of 0.6 would give one-third more maximum power than the one cutting off at 0.75 is evidently impossible.

The importance of maximum obtainable power has already been stated.

We will next consider the difference of efficiency guarantees for the above four engines, and all on the same basis as to steam and vacuum. The order is changed from that in the previous table:

Percentage Rating.

-	50.	100.	150.
No. 1.	13.75	12.50	13.25
No. 2.	12.75	12.50	13.50
No. 3.	14.00	13.00	14.00
No. 4.	15.00	12.75	14.00

If the above stated water consumptions are correct, and if, for this comparison, we consider the gross amount to be allowed annually for depreciation and repairs to be the same for all engines, then it is evident that the No. 1 engine is the best if the average load is above rating, and No. 2 if it is below rating.

How much more, based on cost of fuel, can we afford to pay for No. 2 than for No. 4 engine?

If the load for one-half of the time is approximately one-half of the load (for one-quarter of the time is approximately rated of the load), and for the final one-quarter of the time is approximately one and one-half of the load, or, say, an average of 88 per cent. (and this is a very high average load for an interurban railway not using storage batteries), and the daily run is 20 hours, and the additional (not pro rata) evaporation be 8 lb. of water per 1 lb. of coal, then the annual saving of No. 2 will be:

Saving Per I. H. P. Daily.

10 hrs. at 2.25, equals	22.50 lbs.
5 " " .25, "	1.25 "
5 " " .50, "	2.50 "
Total	26.25 lbs.

If the average indicated horse-power is 1,000 h.p., then the pounds of steam saved annually is, in round numbers, 9,600,000 lb.

Evaporation 8 to 1—Coal equals 1,200,000 lb. = 600 tons.

At $2 coal, we save each year $1,200 (A).

At $3 coal, we save each year $1,800 (B).

Capitalizing "A" at 6 per cent, equals $20,000.

Capitalizing "B" at 6 per cent. equals $30,000.

It is natural to hesitate at paying $20,000 or $30,000 more for one 1,200-h.p. engine than for another, nevertheless, on the guarantees, we could afford to do so. If the engine guaranteed as the more economical as to fuel is also better designed and manufactured, there is an additional reason for purchasing such engine even at a greater first cost, but how nearly do the guarantees represent the facts? The answer can only be a matter for the exercise of judgment, and considering technical features, standing of the bidder and proven results.

The foregoing shows the results which may be obtained by the investigation of only one feature, and also the importance of making comparisons on the basis of operating conditions, which latter, if not existing, must be predetermined.

The average load above considered is a high percentage of the rating, and if, in order to make the comparison over a greater range, we consider that No. 2 engine at 0.3 load would take 14 lb. and No. 4 17 lb., and that the load for

¼ time is approximately	0.3 load.
½ " " "	.5 "
⅛ " " "	rated "
⅛ " " "	1.5 "

the daily difference in pounds of steam per indicated horse-power will be:

5 × 3 = 15
10 × 2.25 = 22.5
2.5 × .25 = .62
2.5 × .5 = 1.25
Total.... 39.4 lbs.

which is 50 per cent. more than the previous result, making

For $2.00 coal	$30,000.00
For $3.00 coal	45,000.00

Probably there would be not less than two engines, and for the greater portion of the time only one would be in operation, if the average time of operation of two engines be simultaneously only one-fifth of that of one engine (one engine 16 hours, two engines 4 hours), and the load conditions for each engine be considered as unchanged, then the total additional amount which we could afford to pay for the two more economical engines would be six-fifths of that for one, or at $2 coal, $36,000, and at $3 coal, $54,000.

If the comparisons were made at rated load, then the annual saving would be approximately one-fifth of that on the first assumption, the difference in value being only, for $2 coal, $4,000, and for $3 coal, $6,000.

The foregoing also shows that a consideration of comparative values must include the cost of coal; this fact is not always appreciated.

The same general considerations apply to the question of the comparative advisability of installing steam engines or steam turbines, as have been mentioned in connection with various engines, and there are some additional considerations, such as comparative space, cost of foundations, etc.

The writer should state at the outset, however, that he believes as good "coal per kilowatt-hour results" can be obtained by using the highest grade of reciprocating engines, properly proportioned to the work, as can now be obtained by the use of turbines, and that, to a considerable degree, the better results reported where turbines have been installed are because the turbine plants have been of a higher grade than the engine plants with which they have been compared. Turbine plants generally have superheated steam, frequently at a higher pressure than the average reciprocating engine, and also with higher vacuum, and they do obtain better efficiency from the standpoint of water per kilowatt-hour than the majority of the engine plants in interurban power houses. But it does not necessarily follow that reciprocating engine plants could not have been so designed as to have obtained equally high efficiency, nor does it follow that the plant which is most efficient from the standpoint of fuel is the most economical, everything considered. I believe in the steam turbine, but do not consider that it has the field to itself, but rather that each case must be considered on its own merits.

Many comparisons which have been published are misleading. For example: Some comparisons are made on the basis of rated load, which have been shown to be inaccurate when applied to a variable load; others are based on pounds of steam per kilowatt-hour taken by the turbine or the engine, and without making allowance for the additional heat energy required to obtain the higher vacuum for the turbine. In this connection it should be noted that the efficiency of the turbine is materially increased by an increased vacuum, whereas this is much less the case for an engine built on commercial lines. For the turbine it is wise to obtain high vacuum, but the cost must not be overlooked.

The steam for the turbine is also usually superheated, and, if the comparison is based on a difference in pounds of steam, it is evident that consideration should be given to the additional heat units in the steam and the cost of supplying such additional heat energy. When considering fuel economy the proper basis of comparison is the per cent. of heat energy transformed into mechanical energy delivered by the mechanism, including the amount of energy required for the auxiliaries.

On this basis a recent comparison, which I made, between the guarantees of a turbine manufacturer and those of an exceptionally high-grade engine, showed such an exceedingly slight difference as to be practically negligible, and a comparatively small difference in operating conditions would throw the balance one way or the other, as would also a slight difference between guaranteed and obtained results. The difference, as tabulated, was slightly in favor of the turbine, with temperature of condensing water at 60°, and with 26 in. vacuum for the engine and 28 in. for the turbine, and with barometer at 30 in., but if the condensing water was at a higher, though probable summer temperature, it would not be found economically desirable to endeavor to obtain at such time so high a vacuum, and therefore, during such time as this condition might exist, the result would be in favor of the engine. Assuming other conditions of operation, there would be a greater difference, and in favor of one or the other, depending upon the assumptions. Therefore for this case decision must be based on other grounds than comparative fuel economy.

A comparison should include at least the following:

(1) First cost, including engine, turbine, generators for each of same, foundations, buildings, traveling crane, sometimes ground, piping, condensing system, superheaters.

(2) Operating expenses, including fuel, oil, labor, repairs and depreciation.

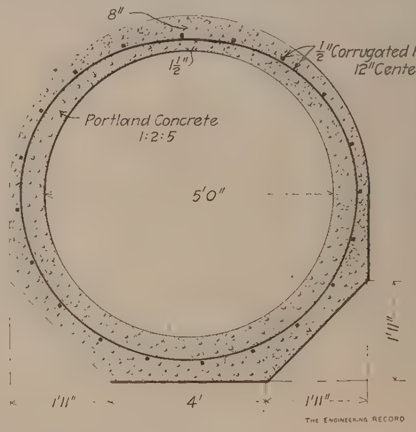
(3) Reliability.

The items under (1) and fuel and oil under (2) can be predetermined with sufficient accuracy for a decision. The other items under (2) and (3) are, for the present at least, largely questions for the exercise of judgment.

A Private Irrigation System in Texas.

A private irrigation system has recently been built about 150 miles southeast of San Antonio, Tex., in the Rio Grande River valley, which required the construction of a masonry diverting dam, with regulator works, and 22 miles of main canal. The dam is on San Felipe Creek, about half a mile below the town of Del Rio, on the Southern Pacific R. R. The principal source of the water supply is a spring with an unvarying flow of about 70,000 gal. per minute, although the run-off from the watershed of the creek above the dam is also available. The main canal extends down the valley from the dam along the base of the foothills, at distances varying from a few feet to a mile and a half from the river.

The dam is a submerged rubble-masonry structure, 12 ft. high and 300 ft. long, placed on a solid rock foundation. The head-gates of the canal are built in one end of it, and at that end the masonry is high enough to prevent its being overflowed. Two reinforced concrete culverts, with an internal diameter of 5 ft., and walls about 1 ft. thick, serve as an outlet to the canal. The ½-in. reinforcing bars used in their construction extend transversely around their barrels and longitudinally with them, on 12-in. centers, the longitudinal bars outside the transverse ones. The cylinders extend through a rubble-masonry wall, 12 ft. thick and 15 ft. high, which has one end abutting against the side hill and the other end joining the dam. They are placed within a few inches of the bottom of this wall and the masonry carried up solid to their tops. A wall, 2 ft. wide on top, with its exposed face vertical and its back face on a slope of 1 to 1, is built over the cylinders at each end, and the remaining space over them is filled with earth to the top of the wall. A gate is placed on the upstream end of each cylinder. These gates slide in vertical steel channels and are operated by a rack and pinion gearing in connection with cogs on the back side of the vertical gate stems. They are so arranged that they can be opened or closed independently, and are provided with gauges showing the amount of flow.



Cross-Section of Reinforced Concrete Siphon.

The canal commences directly below these gates, and for 8,700 ft. is carried in a cut, which was made for the greater part of the distance through rock overlaid with earth. One 18-ft. and three 32-ft. storm-water culverts are provided in this length of the canal, which terminates at a very steep and treacherous side hill. The water in the canal is conveyed around the edge of this hill in a reinforced concrete conduit 5 ft. in diameter and 850 ft. long, forming inverted siphons at several points along its length. The cross-section of this conduit is shown in an accompanying cut. It is laid on a grade of about 4½ ft. to the 1,000 ft., and has a theoretical capacity of about 155 cu. ft. per second.

In the section of the State through which the canal is built the rain, when it comes, is generally very heavy and of short duration. This condition, added to the abrupt nature of the country, makes the run-off very great and necessitates some means for carrying the large storm-water flow across the path of the canal, which is built at right angles to the waterways emptying into the river. All the large natural drainage openings were left intact and the canal is carried underneath their bottoms in reinforced concrete siphons, thus eliminating any danger of damage from floods. The canal is built over the smaller waterways and outlets provided for storm water at these points either by masonry culverts or by vitrified pipes laid in masonry.

From the end of the siphon on the hill side the canal leads along the hill and across the deeply-gulched river valley for three miles, and is made up of a succession of cuts and fills. In two miles, extending from the end of the second mile of the canal to the end of the fourth mile of it, there are seventeen inverted siphons under natural drainage channels. The narrowest of these is 16 ft. wide, and the widest 320 ft., while the total width of the drainage channels in this distance is 1,112 ft. The siphons are usually built with concrete wing walls on both ends, and the canal adjacent to them is lined with concrete. The flow through the siphons varies under different conditions, and has a maximum velocity of 8½ ft. per second.

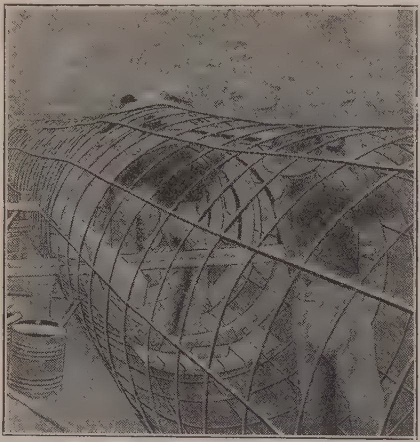
An Inverted Concrete Siphon.

Concrete Walls on the Del Rio Irrigation Canal.

Concrete Siphon Along Side Hill.

From the end of the canal in the three miles of cutting the channel is carried for about a mile through a cut which had to be lined with concrete walls, and in some places with a concrete bottom, to prevent an excessive loss of water by percolation. This cut and those on the three miles above it were largely made with steam shovels, the spoil being handled in dump cars operating on narrow-gauge tracks. The concrete walls are continued to a solid rock summit cut about 30 ft. deep, and there the canal leads into the Rio Grande valley. For seven miles it continues across the valley to a crossing of Sycamore Creek at about 11¼ miles from the dam. The upper 3 miles of this 7 miles, with the exception of the crossing of a few deep, narrow gulches, required comparatively light work. From the end of that work to the crossing of Sycamore Creek, the canal passes through some unusually rugged country, and although it is built on the more level ground at the foot of the hills, the gulches and storm-water channels extend across its path and occasioned the carrying on of heavy work before a waterway was provided. Several drainage channels of considerable width also had to be left practically as they existed, and required the construction of concrete siphons from 100 ft. to 350 ft. in length.

The crossing of Sycamore Creek is accomplished through an inverted siphon 2,200 ft. long. Beyond this crossing the work is very light for about 4½ miles, and the canal is carried largely between earth embankments. In the next mile the work required some large cuts and fills, at the end of which, about 17 miles from the dam, the valley drops away rapidly, so that it was possible to introduce a vertical fall of about 22½ ft. in the canal at one point. This fall will be developed for power purposes, and together with that available at different points along the canal, will produce about 1,200 h.p.



Placing Reinforcement Rods and Inside Forms for Concrete Siphons.

The last five miles of the canal, extending from this fall to the end of the channel as far as it is constructed, is carried between earth embankments.

The dimensions and capacity of the canal are based on calculations made with Kutter's formula, and the results obtained were checked by Coffin's hydraulic graphics. The channel is in general 16 ft. wide on the bottom. Usually the slopes in earth cuts are 1 on 2, in rock cuts 5 on 1, and in embankments 1 on 1½. The upper 5 miles were built on a uniform grade of 4½ ft. in 10,000 ft., except at the points where the inverted siphons are inserted. The remainder of the canal was built on a uniform grade of 3 ft. in 10,000 ft. in open channel, with sufficient difference in elevation between the ends of the siphons to insure a good flow through them. The velocity of flow is about 2½ ft. per second in the open channels.

There were 90,000 cu. yd. of solid rock excavation, 120,000 cu. yd. of loose rock excavation, and 1,750,000 cu. yd. of earth work in the canal. In all, 5 miles of concrete walls were built and 2 miles of vitrified pipe were required. The total length of concrete conduits, including the one around the side hill and those under the drainage channels, is 8,000 ft. About 110 tons of steel reinforcing bars were used in their construction.

The system was built for Mr. G. Bedell Moore of San Antonio, Tex., and cost nearly $1,000,000. It will furnish water to an area of about 15,000 acres, and as the normal capacity of the canal is about 155 cu. ft. per second, an allowance of something over 1 cu. ft. per second per 100 acres, not including losses from percolation, evaporation and seepage, will be provided. The system was designed, located, and its construction superintended by Mr. Jno. W. Maxcy, of Houston, Tex.

Power to Drive Machine Tools.

Machine tool driving was recently subjected to formulas by Mr. J. M. Barr in the "Electric Club Journal." The formulas are based on standard American practice, and under unusual conditions of operation the power required may be greater than that found from the formula. The figures are based on a cutting speed of approximately 20 ft. per minute, the assumption being that water-hardened steels are used, and also that the work is done upon a normal machine tool, as distinguished from the modern high-speed machinery. Where the cutting speed is more than 20 ft. per minute, the horse-power required should be increased approximately in proportion to the increase in speed. Lathes—Engine lathes: h.p. = 0.15 S — 1 h. p.; heavy engine lathes, such as forge lathes: h.p. = 0.234 S — 2 h.p.; in both cases S is the swing of lathe in inches. Boring mills.—For heavy work: h.p. = 0.25 S — 4 h.p., where S = swing of mill in inches. This formula applies more particularly to mills having a 30-in. swing and above; for smaller boring mills the formula as given in connection with heavy engine lathes will be approximately correct. Milling machines.—h.p. = 0.3 W, where W = distance between housings in inches. Drill Presses.—Steel drills, running at a peripheral cutting speed of approximately 20 ft. per minute: h.p. = 0.06 S; for heavy radial drill presses: h.p. = 0.1 S, where S = capacity of drill in inches. Slotters.—Normal crank slotters, at cutting speeds of 15 to 20 ft. per minute: for a stroke of 10, 18 or 30 in. the horse-power is 5, 7 and 10, respectively. Shapers.—Shapers for a stroke of 16, 18, 24 or 30 in. the horse-power is 3, 3½, 5 and 6½, respectively. Planers.—h.p. = 3 W; for heavy forge planers: h.p. = 4.92 W, where W = width between housings in feet. These formulas comprehend two operating tools.

The Indianapolis & Cincinnati Single-Phase Line.

The interest taken in the Westinghouse single-phase electric railway system is so great that the inauguration of the service on the Indianapolis & Cincinnati Traction Co. will attract more than ordinary attention. The first car was put in service on Dec. 30, 1904, and regular service was commenced between Rushville and Morristown, 16 miles distant, on Jan. 21. The company was organized to construct a line from Indianapolis via Rushville and Connersville, Ind., and Hamilton, Ohio, to Cincinnati. The affairs are managed by a board of directors, constituted as follows: Charles L. Henry, Indianapolis, president and general manager; Ephraim Marsh, vice-president; Wm. L. Taylor, secretary; Endorus M. Johnson, treasurer; James W. Fesler, Theodore F. Rose and Wm. M. Frazee.

The dominant idea in the minds of the originators of this company was to build a double-track through line from Indianapolis to Cincinnati, which would take care of the traffic between these two cities in a more satisfactory way than is now done by the steam roads. To this end the company has secured a most desirable private right of way. Where the land is level and there are no considerable fills or cuts, a right of way 4 rods wide has been purchased, but wherever a considerable fill or cut has been necessary, additional width of right of way has been secured. In all the smaller towns a private right of way has been continued through, and the road is not constructed upon streets or highways except in cities or towns of such size as to make it necessary. In all cases sharp curves are avoided, and such an alignment has been secured between cities and towns as will permit of very rapid running, with entire safety to passengers and equipment. In most instances the right of way is protected by a woven-wire fence, erected under an agreement with the land owner, whereby the land owner maintains the fence and keeps all its gates closed. Wherever such an agreement was not secured the right of way is fenced with barbed wire.

Under the provision of the franchise of the Indianapolis Traction & Terminal Co., interurban lines are allowed to enter the city over the tracks of the city company by such routes as the city designates, upon payment to the city company of an agreed or ascertained compensation. The Indianapolis Traction & Terminal Co. has made a uniform agreement with interurban roads for entrance into the city over its tracks, whereby interurban roads pay 4 cents for each passenger carried on the interurban cars while on the city lines, and this entitles them to all of the privileges of the terminal station.

The line has already been constructed between Indianapolis and Rushville, a distance of 41 miles, and a through service between those cities has been established. At an early date the road will be extended to Connersville.

The construction of the roadway is thoroughly first-class and steam railroad standards are used. Between Indianapolis and a point 8 miles east of Rushville—a distance of nearly 50 miles—there is no grade exceeding 1½ per cent. From that point on toward Cincinnati the country is less level, and in some cases straight lines have been preferred, even at the expense of some increase in grade; but with the alignment and grade considered together, greater speed can be obtained, with comfort and safety to passengers, than on any steam road now running between Indianapolis and Cincinnati. So far as the profile of the road has been as yet determined, the heaviest grade will be 4 per cent., and it is believed that no greater grade will be necessary on the entire line. The roadbed is graded 28 ft. wide on top for a double track, with slopes on fills and in cuts of 1½ to 1, and upon a grade line that puts the track in most instances above the level of adjacent lands, so as to avoid trouble on account of snow.

The bridges across all streams are constructed either with concrete arches or steel girders with stone abutments. The superstructures were built by the Indiana Bridge Co., of Muncie, Ind., of a capacity sufficient to carry a train of cars with a gross weight of 100 tons for each car. All abutments are built for double track; the superstructures at this time are laid for one track only.

The road is laid with double track in the city of Rushville and on all highways; but on the private right of way, while the grade is prepared for double track, only one has been laid, as a second track can be more conveniently and economically put down later, when a sufficient portion of the road is in operation to require a double track. All ties used are first-class—no culls or seconds—white oak, burr oak and a few chestnuts, 6x8 in. x 8 ft. long, 3,280 to the mile. The bridge ties are of long leaf yellow pine.

Oil-Burning Boilers.

The track is laid with 70-lb. T-rail, in 60-ft. lengths, connected with Weber rail-joints, and bonded at the joints with No. 0000 10-in. copper bonds, with ⅞-in. terminals under the plate so as not to be exposed. Cross bonds are put in every half mile and long bonds under all special work. The switches and other special work have been furnished by the Buda Foundry & Manufacturing Co., of Chicago, and are built according to steam railway standards. Turnouts and cross-overs are constructed so as to avoid danger of open switches.

The company has secured a fine gravel pit, located within ½ mile of its main line at Morristown, Ind. The first layer of ballast has been put on the roads from Rushville to Indianapolis, and the work will be completed as soon as the weather permits. The road is to be ballasted with gravel 8 in. under the ties and level with the top of the rail. In the streets of Rushville an 8-in. layer of broken stone was placed under the ties.

The system of electrical distribution requires transformer stations about 10 miles or 12 miles apart, and the alternating current is transmitted from the power house to these transformer stations at 33,000 volts, single-phase, 25 cycles per second, and is reduced and fed into the trolley at a potential of 3,300 volts. The high-tension current is carried from the central power station to the transformer stations on No. 4 bare copper wires, two wires to each transformer station. They make a complete circuit and permit the placing of the circuit breakers and switches at the central power house, so as to do away with the necessity of attendants at the transformer stations. The high-tension lines are carried on a separate line of poles set near the edge of the right of way, provided with carefully and strongly constructed cross-arms and equipped with large porcelain insulators on iron pins. The trolley wire is No. 000 grooved copper, supported by a catenary suspension system from poles 100 ft. apart. The overhead material for the entire line construction was supplied by the Westinghouse Electric & Manufacturing Co., according to the design of Sargent & Lundy, consulting engineers.

The entire system is provided with two metallic circuit (four copper wires) telephone lines, one of which is used exclusively by the train despatcher. The other line is used for general company business. Each car is provided with a telephone, by means of which the conductor can talk with the despatcher at fixed points. Jack boxes are placed on the poles at intervals of 2,000 ft., from any of which the conductor of a car or any one else with a telephone can call up to report an accident or for any other purpose.

Within the limits of the city of Indianapolis, a distance of approximately 3 miles, the cars will be run over already existing lines, and will be operated by direct current at 550 volts. Within the limits of the city of Rushville they will be operated by alternating current at the same potential; on intervening sections the troley will be fed by alternating current at 3,300 volts, 25 cycles per second, single-phase. Thus the first single-phase railway exemplifies the possibility of operating the same equipment from both direct and alternating-current lines, and illustrates the voltage flexibility of the system, one of its most advantageous features.

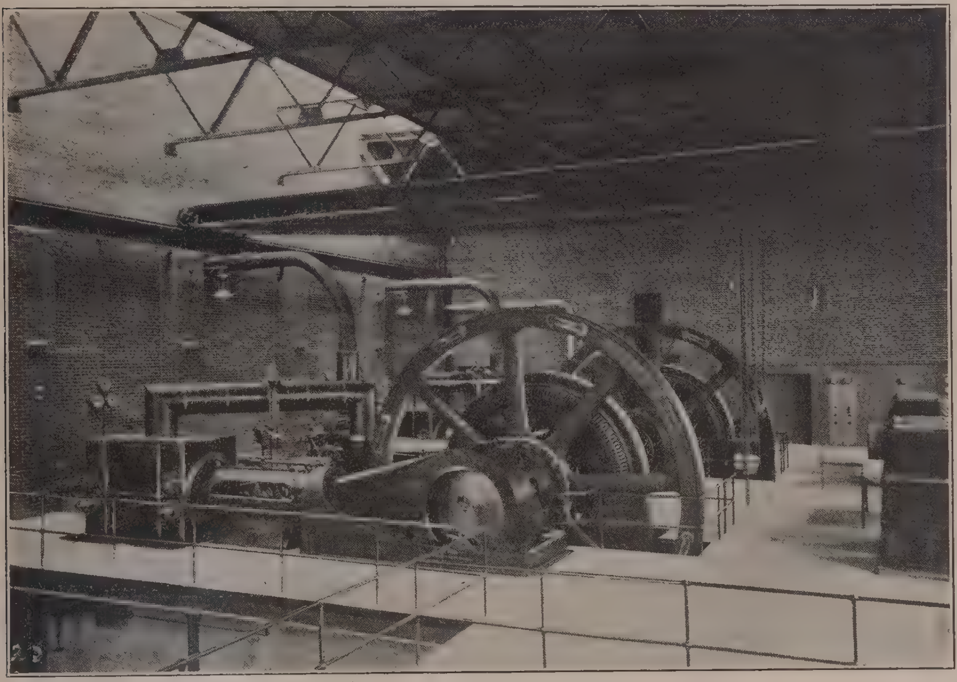
The power station from which it is intended to operate the entire road is located at Rushville. From this plant 33,000-volt transmission circuits are run to the points of transformation and there reduced to 3,300 volts before connection to the trolley.

As has been stated, the road is divided into sections of 10 miles and 12 miles, each of which is supplied with current from a transformer station. Three such stations have been erected between Indianapolis and Rushville. In each there are at present installed two 300-kw. oil-insulated step-down transformers, 33,000 volts to 3,300 volts. Space has been provided for an additional transformer of the same capacity. On the second floor of each transformer station there are installed the lightning arresters and disconnecting switches. There are no automatic switches of any type in these stations, as they are controlled only through the switchboard in the power station. There is nothing at the station which requires constant attention, and only occasional inspection will be necessary. This does away entirely with the expense usually incident to the rotary substation of other systems, which, if three men are employed, would aggregate about $6 per day. The annual saving in wages on the three transformer stations between Indianapolis and Rushville made possible by the alternating-current system on this basis, would amount therefore to $6,570, or a total annual saving on the ten transformer stations between Indianapolis and Cincinnati in wages alone of $21,900.

The entire electrical equipment of the transformer stations was furnished by the Westinghouse Electric & Manufacturing Co., and was installed under the supervision of Sargent & Lundy. The disconnecting switches were made from a design specially prepared for this service by these engineers.

The power house serves as an additional transformer station, and contains two 300-kw. lowering transformers, wound for 3,300 volts primary and 550 volts secondary circuits, which are used to feed that portion of trolley included within the limits of the city of Rushville.

The power house is a strictly fireproof building of brick, concrete and steel, with rooms well lighted and skilfully arranged for future addition and enlargement. The site is adjacent to the Cincinnati, Hamilton & Dayton Ry., with a connecting track from that road to the company's track alongside of the power station.



Engine Room of the Indianapolis & Cincinnati Traction Co.

The boiler room occupies one side of the building, and is at present equipped with three 350-h.p. Babcock & Wilcox boilers. Natural gas is now being used for fuel, but provision is made for the burning of coal, if at any time the supply of gas becomes insufficient. The engine room occupies the other side of the building, and is separated into two parts by a heavy brick partition. In the main room are installed the two generator units, which consist of a 500-kw. Westinghouse revolving field alternator, 25 cycles per second, direct connected to a 700-h.p. Corliss type, cross-compound, condensing engine, built by the Fulton Iron Works, of St. Louis, Mo. Both engines and generators are designed for an overload capacity of 50 per cent. Each engine is equipped with an independent jet condenser, made by the Dean Brothers Steam Pump Works, of Indianapolis, which take their water from an underground tunnel connecting to a large mill race. Two pairs of 250-kw. air-blast transformers are arranged to change the current which comes from the generator at 2,300 volts, three-phase, to 33,000 volts, two-phase, for transmission to the transformer station along the line. Air for these transformers is supplied by two motor-driven blowers. The generator field is excited by direct-current generators, one of which is direct-connected to an alternating-current type C Westinghouse induction motor; the other to a Westinghouse compound steam engine. The marble switchboard controlling panels are also located in this main engine room, and the controlling apparatus is installed in the other portion of the building, which is known as the high-tension chamber. The main bus-bars are located in the basement and are supported upon a masonry structure and separated by barriers of alberine stone.

The car shops are located near the power station. The entire building is 205x104 ft., and is divided as follows: Offices and waiting room for train crews, storeroom, blacksmith shop, car wash room, machine shop, truck repair shop, room for winding and drying armature and field coils, and for other electrical work, paint shop and carpenter shop. Six tracks enter the building, each of which is provided with a working pit. A transfer track runs across the center of the building.

The present equipment of the company consists of ten passenger cars constructed by the St. Louis Car Co. Each measures 55 ft. over all, and is divided into three compartments. The first compartment is 9 ft. 10 in. long, and is intended to carry baggage. It is provided with doors opening on either side. The cars are intended for single-end operation, and space for the motorman is provided in the front of the baggage compartment, from which it is separated by a strong railing made of pipe. The middle compartment has a seating capacity of sixteen people and is intended for men desiring to smoke. The third compartment occupies the remaining portion of the car, and has a seating capacity for thirty-eight people. Each car is equipped with two trolleys, one of the Union Standard type, with trolley wheel, to be used when operating from the direct-current lines in Indianapolis, or from the low-voltage alternating-current lines in Rushville; the second trolley is of the bow, high-speed type, and has been designed for service at 3,300 volts, alternating current.

Local cars are operated each way every hour, making stops upon signals at all of the cities and towns and at the principal highway crossings in the country. They are designed to run at a schedule speed of 30 miles per hour. To properly take care of the through service, additional "limited" cars will be put on the line; each of these will be equipped with four 150-h.p. motors, designed to operate at a schedule speed of 50 miles per hour or 60 miles per hour, as under the provisions of the various franchises they will not have to make any stops in the country or at any of the smaller towns, and will only be required to make one stop at each of the larger intervening cities. It is expected that when the road is completed from Indianapolis to Cincinnati these "limited" cars will be able to make the trip from the center of one city to the center of the other in three hours' time. It is the intention at a later date to run two express cars per day in each direction, taking care of the light freight and express business.

This road has been built in every detail with a view to the handling of heavy freight, even to the extent of carrying it in long trains. Whenever, in the intervening cities, short radius curves could not be otherwise avoided, the private property of the inside corner has been purchased and the sidewalks and curbs set back so as to make easy curves and permit the handling of heavy trains.

An average fare of 1½ cents per mile is charged by the company for carrying passengers, the road being divided into 5-cent sections; no fare less than 5 cents is charged for any ride. A school children's ticket is issued, good for use one hour before or after school hours. A mileage or sectional ticket is also issued at a reduced rate, giving 160 5-cent rides for $7, a reduction of 12 per cent. from the ordinary fare. No other tickets are sold and cash fares are collected on the car.

John W. Moore, chief engineer of the Indianapolis & Cincinnati Traction Co., has been particularly active in the construction of the roadway, bridges and track work. Arthur A. Anderson, general superintendent of the company, has carefully supervised the entire work of construction and operation.

Steam Generation from Coke-Oven Gas.

The utilization of coke-oven gas in steam boilers was described some time ago in the London "Engineer." The gas from 22 bee-hive ovens 11 ft. in diameter was supplied to a Stirling boiler having 1,611 sq. ft. of boiler heating surface, and gas from 37 similar ovens was supplied to a 28x8-ft. Lancashire boiler, having 1,796 sq. ft. of surface. The boiler heating surface in the first case was 73.4 sq. ft. per oven; and in the second case 48.6 sq. ft. per oven. The water evaporated from and at 212° Fahr., per pound of coal coked was 1.7 lb. in the first case and 1.32 lb. in the second case; the equivalent evaporation per oven per hour was 294 lb. in the first case and 230 lb. in the second. The approximate temperature of the gas at entry to the boiler was 1,720° in the first case and 1,700° in the second; and the approximate temperature leaving the boiler was 650° in the first case and 750° in the second. Allowing an evaporation of 4 lb. per square foot of heating surface with the boiler coal fired, in the case of the first boiler, the evaporation secured was 100.3 per cent. of the so-called normal evaporation in the first case; and allowing similarly a unit evaporation of 7 lb. per square foot of heating surface in the Lancashire boiler, the percentage secured in the second case was 68 per cent. The boiler was situated 29 ft. from the outlets from the ovens and the gases lost apparently 300° temperature in transit.

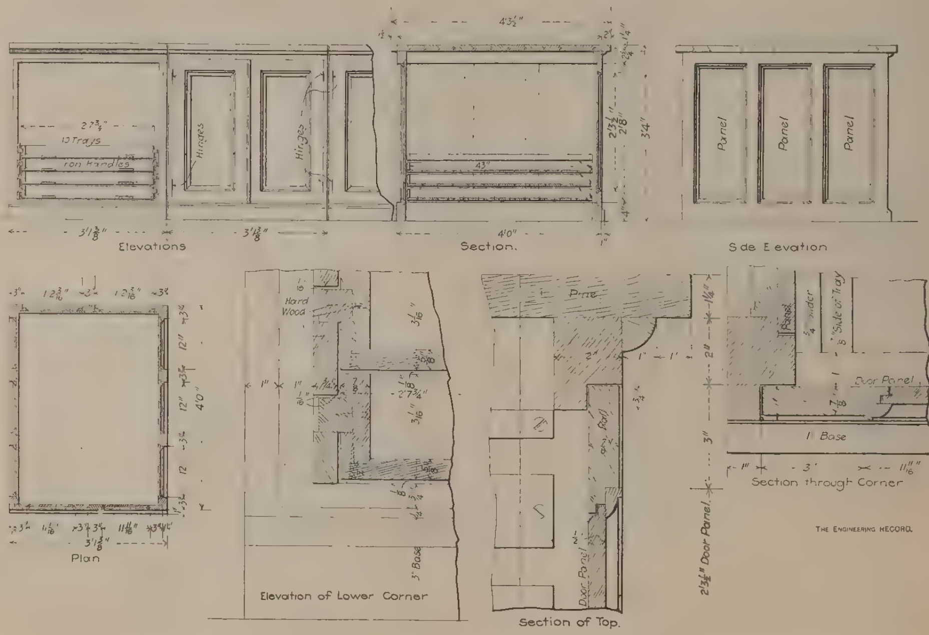
Filing and Indexing Tracings of Railroad Bridges.

The system chosen and the details developed for filing and indexing drawings is an important consideration in any large engineering organization. Where subjects of construction, reconstruction, manufacture, design or record are involved and reference to the data is frequently or occasionally required, it is very essential that the drawings should be safely preserved, conveniently arranged, accessibly stored and indexed so that any required information can be quickly located and easily secured. Most large engineering offices have adopted or developed more or less complete and satisfactory systems of filing and indexing drawings, a number of which have been, from time to time, illustrated and described in these columns. They necessarily differ widely on account of the different classes of work and the varying requirements for the use of the data. In many instances the business or engineering department has grown up from very small beginnings and has often been hampered by over-work and changes of administration, so that in some cases the systems are not as efficient as they should be or as they probably would be if they had been formally planned with a complete initial knowledge of the magnitude and requirements of the service. In such cases, and even in others where the systems are carefully designed, there is often difficulty in providing satisfactory storage for the tracings and in securing uniformity and completeness in routine data. These points have been especially well covered in the system now adopted in the office of the bridge engineer of the Erie R. R. Co., New York.

There are owned and operated by the Erie R. R. Co. about 2,500 miles of track, some of which has two, three and even four-track structures. It is divided into sixteen principal divisions, besides which there are many branches and spurs, and the bridges which are built or maintained by the railroad company now number 4,000, including 700 masonry arch bridges and all openings which cannot be spanned by the rails, say, above 16 in. in the clear.

All drawings for the bridge structures are made on sheets of tracing cloth with a standard width of 22½ in. of any necessary length, folded to 36 in. The ends are punched and they are arranged in sets, sometimes secured with brass paper fasteners. For girder bridges and other short spans the drawings are often made within 8x12½-in. limits, the size of a sheet of legal cap paper, and are arranged symmetrically across a standard sheet of tracing cloth 22½ in. wide. Generally, the data for the wooden floor is put at the top of the sheet, the strain sheet next, and the masonry sheet at the foot of the sheet, thus enabling all three to be blueprinted at once and filed away on a single standard-size sheet, an arrangement which obviates the difficulty before experienced of losing or displacing the small sheets. The small sheets can be cut apart and put with specifications or correspondence on pages of the same size, or they can be trimmed down to neat dimensions, except at the left hand of the upper sheet, where a wide margin is left. The pages are folded on horizontal lines separating them, but are not cut apart. The upper left-hand margin is punched with standard spacing and bound between adjustable covers to make part of any book or collection required for reference or field work.

Each full-size set of prints is bound in a cover of heavy manila paper marked with the number and title of the bridge. These sets, containing from 1 to 100 sheets, are stored in special cabinets which were designed in the office of the bridge engineer and were made to order. The cabinets are built in sections a fraction more than 3 ft. wide and 4 ft. long. The top is perfectly flat, is made of thick, stiff boards, and has a height of 40 in. above the floor, so as to serve conveniently as a table for the examination of drawings or for other purposes. The sections are made with the ends flush, so that they fit closely together and make a continuous drawing table of any required length. The sides and ends of the sections are paneled and the front is closed by a pair of doors which open so as to disclose the whole area of the interior and clear the full-width drawers, which are shallow trays with the vertical side pieces omitted on the front edges. They have horizontal cover strips on the upper edges at the rear end to confine the ends of the sheets and prevent them from engaging the upper drawers when they are pulled out. Each drawer will store about 200 sheets of tracings, which are thus always kept perfectly flat and smooth, and can be easily selected from inspection of the marks and titles on the covers of the different sets. Each section of the cabinet contains ten trays, and therefore has a capacity of about 2,000 drawings. At present there are eight sections of the cabinet in use in the office of the bridge engineer. A special feature of the design of these trays is that they are supported by ribs projecting from the centers of the sides and engaging the slots between bearing strips fastened to the walls of the cabinet. These ribs and strips are made of hardwood, polished and lubricated with a little soap or plumbago, so that the drawers slide very easily.



Cabinet for Filing Standard Bridge Tracings.

The cabinets are fitted with bronze hardware and are very neatly finished. The exteriors, except the tops, are made of ash filled and varnished, the interiors and tops are of white pine, and the trays are shellaced. The cabinets were delivered in separate pieces and were put together in the offices with screws. The lengths of the tops were made ⅛ in. full, and were planed in position, so that the adjacent sections fitted together perfectly with smooth joints in the table portion. The sections are nominally entirely separate, but they are actually secured by two or three screws connecting the adjacent sides of successive sections.

The drawings in the cabinets are indexed simply by the number of the bridge to which they refer, each set of the drawings thus having one number and all drawings belonging to that bridge having the same number, and being bound together in the same cover or sets of covers for that structure. These numbers are recorded in a general index book, which is ruled in four columns. Each page is dated and headed with the division number and branch. The first column contains the new numbers of the bridges, which are simply the record of the position on the railroad, expressed by the number of the nearest mile post and the hundredths of a mile to it, together with the prefix of the letter H when the bridge carries a highway, and prefixed by letter F, indicating foreign, when the bridge is not maintained by the Erie R. R. Co. For example, in one sheet of the Delaware Division the first bridge is numbered H 87.80, and the last one is numbered 157.02. The second column of the table contains the former bridge number, with the name of the nearest station. The third column is headed "Kind of bridge," and the entries in it are like the following: Pratt through. 12-in. I-Beam Deck. Plate-Girder deck. Wood, Erie standard. Post through, etc. The fourth column tells the purpose of the structure and is headed "Crosses." In it the entries are like the following: Erie Railroad, Main Line. Watercourse. Tannery Creek. Delaware River. Highway. Callicoon Creek and Highway, etc.

The general bridge list from which this index is prepared is made on blanks like the accompanying sample, which are filled out by the division engineers, who preserve a blue-print copy and return the original to the main office. It is there filed for reference and serves as a skeleton record from which reliable general information can always be secured instantly. The original sheets are corrected in red ink from time to time as charges are made and reported, and new blanks are issued and filed to show the latest state of affairs.

Three different blanks are issued, one for square crossings, one for right-handed skews, and one for left-handed skews, all of them substantially like the one here illustrated, which is considered a right-handed skew. With these blanks is issued a page of instructions which directs that the data should be written in on the blank with black drawing ink, and that all of it for the same division should be done, for the sake of uniformity, by one person. The right-hand end of the sheet is always considered east, and when, on branch lines, it is doubtful which is east, the names of the termini are written on it. Where piers exist between the abutments they are drawn in on the sketch and measurements added.

Where backwalls do not exist, the fact is noted and the distance A is recorded as the length over stringers. Where skew bridges have the stringer backwalls squared, the distance A is given as for the regular skew line, and an explanatory note is added. Where bridges of different kinds exist side by side at the same opening, they are recorded on separate sheets, which are numbered, and on them it is noted whether the structure is for the east-bound, west-bound or side tracks, and the number of the sheets in the set is recorded on each sheet. These records are thus made to show the general condition and changes of the work, but are never used for ordering changes, repairs or new work, for which purposes special surveys are made.

Besides the general index and this set of record sheets, a third index is maintained of all masonry arches on the line. Each page of this is ruled in twelve vertical columns with twenty-four horizontal lines. The first column designates the name and locality of the bridge by the nearest mile post and hundredths of a mile, as before explained. The second column has the old number or name, the third the nearest station, the fourth states whether the structure is for a running track or siding, the fifth gives the number of tracks crossing the arch, the sixth the county in which it is located, seventh the State, eighth the material, such as rubble masonry or cut stone, the ninth the clear span between side walls, tenth the length of barrel, eleventh the height of side walls, and twelfth the distance from the floor of the arch to the base of rail.

This system of arrangement, recording and indexing has been found very convenient and satisfactory and is in line with the spirit of standardizing and systemization which prevails in the office, and by means of which a great deal of routine work is done once for all, so as to be available for future requirements of the same kind, and saves a great amount of duplicate work. Many of the details which occur frequently in the structures themselves have been standardized and tables have been prepared by which calculation and design can be largely facilitated by inspection.

This work has been planned and directed by Mr. Mason R. Strong, engineer of bridges.

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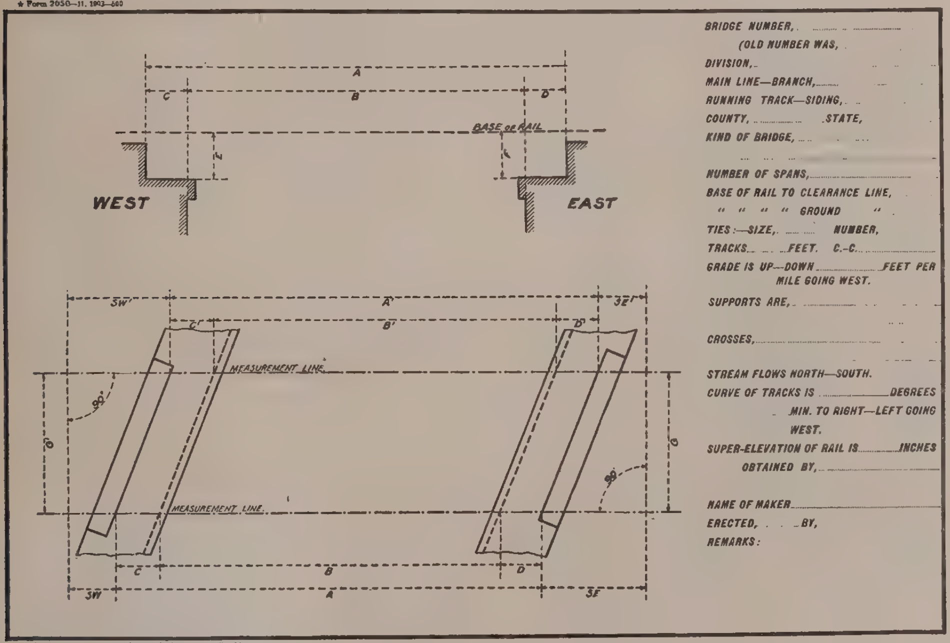


BRIDGE NUMBER,
(OLD NUMBER WAS,
DIVISION,
MAIN LINE—BRANCH,
RUNNING TRACK—SIDING,
COUNTY, STATE,
KIND OF BRIDGE,
NUMBER OF SPANS,
BASE OF RAIL TO CLEARANCE LINE,
" " " " GROUND "
TIES:—SIZE, NUMBER,
TRACKS FEET. C.-C.
GRADE IS UP—DOWN FEET PER MILE GOING WEST.
SUPPORTS ARE,
CROSSES,
STREAM FLOWS NORTH—SOUTH.
CURVE OF TRACKS IS DEGREES MIN. TO RIGHT—LEFT GOING WEST.
SUPER-ELEVATION OF RAIL IS INCHES OBTAINED BY,
NAME OF MAKER
ERECTED, BY,
REMARKS:

ERIE RAILROAD CO., OFFICE OF CHIEF ENGINEER, MAY, 1901.

Standard Blank for Reports and Principal Data of Bridges.

Economies Obtainable by Various Uses of Steam in a Combined Power and Heating Plant.

In the last issue of this journal there was printed a summary of an unusually interesting report on a central power and heating plant for the executive buildings in Washington. This report, by Messrs. B. R. Green and S. Homer Woodbridge, was accompanied by a number of appendices by the latter, one of which was a very complete discussion of the economies obtainable by various uses of steam in a combined power and heating plant. This study was limited to a single building, considered first, as isolated, having an independent power and heating system; and, second, as a part of a common system dependent on a central station and power plant. The building requires an average of 200 h.p. during the year for power and for light, and an average of 300 h.p. for six months of the year for heating and ventilating.

Considering the building, first, as equipped with its own plant, Prof. Woodbridge states that it may be furnished for doing mechanical and heating work by either of the following methods:

(A) Heating with live steam direct from the boilers, the exhaust steam from pumps, engines, etc., being thrown outboard to waste at atmospheric pressure.

(B) Heating with live steam from boilers, the engines being of a condensing type, and the exhaust steam when condensed being carried with the condensing water to waste.

(C) Heating with exhaust steam from the engines, the engines exhausting at or near atmospheric pressure into the heating system.

(D) Heating with exhaust steam, that steam being used for heating water which is made the medium for the transfer of the heat of that exhaust to the building and its air, the temperature of that water being kept so low that it may be used for condensing steam at a vacuum of 25 in. or so, the water being circulated rapidly by means of rotary pumps, and being additionally heated, when required, by live steam after leaving the condenser.

The first method (A) is not found in any of the Executive group. The wholly unnecessary waste attending its use is evident.

The second method (B) is given conspicuous illustration in some of the largest Government buildings. The plan has been adopted in these buildings for the purpose of increasing the effective work of the engines the year round by condensing methods and resulting vacuum exhaust. The method has no reference to combining economy of power with economy of heating.

It means, in the first place, a waste, due to the use of from 60,000 to 100,000 gal. of water for every ton of coal burned for power, according to the temperature of the water used and the degree of vacuum maintained. This item becomes more important as the water furnished is first either pumped to a high-service city reservoir, or is a part of the water filtered through the city's filter beds. In the second place, it means a gain due to increased fuel economy resulting from running engines under high vacuum, and also at an initial, or boiler, steam pressure of 125 lb., the gain being, roughly, 50 per cent. over the cost of doing the same work with an initial pressure of 80 lb. and exhausting at atmospheric pressure.

The annual coal quantities required for the suppositive building, for heating and for power by each of the four methods outlined, may be estimated as follows:

By Method A.—Three hundred boiler horsepower is approximately equivalent to 9,000 lb. of steam per hour, as boilers are ordinarily operated. That evaporation requires approximately 1,000 lb. of coal for its production. If the building is heated by the indirect method, and fans must be driven for the distribution of air through flues, the heating and ventilating system must probably be in daily operation on an average of 15 out of the 24 hours, making the average consumption of fuel 7½ tons per day; or the total yearly burning, 1,350 tons for the heating system alone.

Similarly, the annual coal supply required for power may be found as follows: 200 b.h.p. equals approximately, as boilers are usually run, 6,000 lb. of steam per hour, or 667 lb. of coal per hour. Power is required so long as fans are run, and with indirect heating, that daily run is likely to be considerably in excess of the per diem working hours. Power is also required for night lighting. The daily power run may be averaged for the year at 12 hours per day, requiring, approximately, four tons of coal per day, or 1,440 tons per year.

The total quantity of coal per year for power and for heating by this wasteful operating method would reach a total of 2,790 tons.

By heating the building by indirect radiation, and by ventilating it when occupied, the cost could be considerably reduced. They could be further reduced by heating only, without ventilation, as is shown by contrasting the records of the State, War, and Navy building and of the Treasury building. The cubic capacity of the Treasury building is 10 million feet, and of the State, War, and Navy building 11,700 feet. The fuel burned the past year for warming the Treasury was 1,240 tons, against 2,500 tons for warming and ventilating the State, War, and Navy building. On the ground of hygienic and vital economy such a method of fuel saving is not to be advocated.

By Method B.—The gain obtainable by condensing engines using high vacuum, and when boiler pressure is maintained at 125 lb., over the coal required for the same work when boiler pressure is 80 lb., and steam is exhausted at atmospheric pressure, is, roughly, 50 per cent. By adopting the high boiler pressure and the high vacuum method, the coal burned for power may be reduced from 1,440 to 960 tons. That required for heating remaining as before, namely 1,350 tons, the total becomes 2,310 tons.

By Method C.—If, on the other hand, the power is produced without condensation, and at a coal consumption of 1,440 tons, then one-half of 1,440, or 720 tons, are by this method of operation available for heating, and the total coal combustion for power and for heating then drops to 1,440+(1,350—720), equal 2,070 tons for the year.

By Method D.—If condensation is made continuous the year round, and if in cold weather the heat of the condensed exhaust steam is used for heating purposes, the power is then furnished by a consumption of 960 tons of coal —as above shown under the heading of B—and half of this, or 480 tons, is available for heating. The total per annum quantity of coal required under these conditions is 960+(1,350—480), equal to a total of 1,830 tons per year.

Represented in per cents, the fuel costs under the four methods for the suppositive building becomes, A, 100; B, 83; C, 74; D, 66.

Considering the suppositive building with reference to connection with a central plant, the following further considerations are of importance.

The estimate thus far made relates to fuel only, as ordinarily burned in an isolated plant, and assumes the evaporation rate and the steam pressure to be as effective and as economically produced as in an aggregated plant. Because of the more complete economizing equipment, and of the better training, discipline, and surveillance of employes in a large, well-planned and highly organized power plant; and also because of the high steam pressure properly and safely carried in the boilers of such a plant, it is probable that a 15 per cent. gain would be made in the matter of coal combustion alone.

Furthermore, in the matter of employes, such a building as that assumed, having its own isolated plant, would require, at least one chief engineer and two assistant engineers, five firemen and two coal passers, beside a corps of electricians. In the case of the connection of the building with a central plant, the power and heat being furnished from an outside source, such force could be reduced to the chief and assistant engineers, and the electricians. Two of the firemen and one coal passer would then be assigned to the power house. The saving effected would then be the salaries of three firemen and one coal passer, having aggregate salaries of $2,750.

In the matter of space, the equivalent of 500 to 600 h.p. boilers, engines, etc., is 100,000 cu. ft. The rental value of such space, for storage alone, at 15 cents per square foot of floor area per year, would be not far from $1,000.

The above estimates of the operating gains procurable by a central plant have not been made to include the difference in cost between soft coal and hard coal. The evaporating value of soft coal as a fuel is 10 to 12 per cent. larger than that for the best grades of anthracite, and the difference in cost between anthracite, now some 60 per cent. higher than bituminous coal, will increase rather than diminish with time. This item is therefore one of large value and might easily reach for the suppositive building $2,500 a year.

To such gains in operative costs should be added another of no insignificant importance, namely, in the saving in equipment necessary to serve the suppositive building, provided it is new and is either to receive its own isolated plant, or else to be served by a central plant made sufficiently large to include that service.

This item becomes of larger importance as the number of buildings served by the central plant is increased, because of the very considerable reduction of reserve power in boilers, engines, and generators made safely possible and practicable. In a building of this character, a reserve boiler, engine, and generator capacity of from 30 to 50 per cent. is usual to meet the emergencies of severe weather and heavy duties, and to provide against accidents. If, however, a considerable number of large buildings are combined in the matter of power, lighting, and heating in one central plant, the total reserve may safely be reduced to 10 or 15 per cent. of the maximum average required by the entire group of buildings.

As electrical installation for light and power usually costs $100 per kilowatt, and the average power for the assumed case is 200 h.p., or 150 kw., the ordinary reserve of 75 kw. in the isolated plant would become not more than 25 or 30 kw. in the combination plant. The saving in installation would then be from $4,500 to $5,000. To this sum must be added a further saving in surplus in boiler power for heating, which, for the suppositive building, can be reduced from 150 h.p. in the segregated plant to 50 h.p. in the aggregated plant, resulting in a further installation saving of some $1,500.

It is furthermore probably true that soft coal would be burned in a central plant with more successful protection against fuel waste in smoke and against smoke nuisance than if the fires were scattered through a dozen different buildings, the firemen of a central power house being supposedly under strict discipline and surveillance rather than under the casual observation and direction of an engineer in each of a dozen buildings. It would be easier to prevent the escape of smoke from one chimney than from a dozen scattered chimneys.

The losses incident to connecting the suppositive building with a combination plant are principally those attending the transmission of power and heat from the central station, and the cost of a heating installation for the building which shall be adapted to a power system employing condensing engines, and, at the same time, to utilizing exhaust steam for heating purposes. The transmission wastes are thermal and electrical. The maximum electrical wastes may be, and usually are, fixed by cable sizes and insulation. The heat losses may be greatly reduced by a liberal use of effective insulating material, and by insuring dryness for piping and covering. If the loss of heat from a naked pipe filled with steam at 212°, and exposed to quiet air at 60°, is 360 thermal units per square foot per hour, the effect of an inch of some good insulating covering is to reduce that loss to 90 thermal units per square foot per hour when the pipe covering is exposed to the same air. By using several inches of the best insulating material, such as loose and finely granulated cork, at comparatively small cost the losses may be reduced to 40 or 50 thermal units per square foot per hour.

The heat losses given in the foregoing portion of this report as probable from pipes of various sizes, and used for conveying a certain definite amount of heat through a fixed distance, have been estimated on bases obtained by experience with covering similar to that described and under conditions of dryness essential to prevention of waste.

Those losses are approximately one-eighth of similar losses reported in recent papers on the subject of heat distribution from central plants, read before various engineering bodies. In a paper presented by Mr. H. T. Yaryan before the American Society of Mechanical Engineers (see vol. 21 of Transactions), is described a heat-distribution plant, with underground piping insulated in the usual commercial manner, the superficial surface of the mains having a ratio of 1 to 4.5 for the radiation surface in the buildings served. The data given in the paper make it appear that the 1 per cent. of surface underground yielded 17 per cent. of the total heat passed into the pipe system; from which it follows that the per square foot rate of heat transmission from the "insulated" piping is 92 per cent. of the rate of heat passage from the naked radiators of all description within the buildings served.

That rate of loss is lower than that given by other papers as the average proportion of the total heat passed into the distributing system, which is placed by some at an average of 20 per cent.

Such losses are their own sufficient commentary on the ineffective character of the insulation provided and on the policy of reducing installation costs at the expense of operating costs. Of first importance is the proper construction of pipe ways and the effective insulation of the pipes.

To reduce heat loss, the walls of a conduit for the conveyance of heat should be impervious to earth moisture and should be effectively protected from all other moisture, and the subways should be sufficiently ventilated to prevent the accumulation of atmospheric moisture and to make the heat serve as a moisture expellant rather than as a means of moisture accumulation.

An advantage in the use of hot water, rather than of steam, for the transfer of heat from a central station to the suppositive building is in the fact that by the leaking of steam a surer diffusion of moisture through the insulating material and space is probable than when the leakage is by the dripping of water at a comparatively low temperature either at a single point or at the isolated points where leakiness occurs; and, furthermore, the lower temperature of pipes favors a lower vapor "tension," and therefore a smaller quantity of water vapor in the air and material surrounding the pipe.

When a high-pressure steam pipe is run through the same insulating channel with its relatively cool return pipe, and where that channel is not protected against moisture, the vapor in the conduit or insulating chamber may easily reach such a high quantity that the dew-point may be above the temperature of the return pipe. In such case, vapor will condense on the surface of that pipe. Such condensation at high temperature on hot pipes and in the presence of air offers conditions favorable for the rapid deterioration of the return or cooler piping. This fact is adverse to the use of steam and favorable to the use of water, because the temperatures of both pipes are, in the first place, low, and, secondly, not as greatly different as in the case of high-pressure steam and low-temperature return.

One cause for the excessive losses of heat reported from distributing mains in commercial heat-distributing plants is to be found in the large number of connections and run-outs between mains and scores of buildings located along the route. Such run-outs are usually protected by imperfect insulation, and run-outs made at manholes expose to some extent the local surface of main lines to convection and radiation losses, making a large aggregate source of heat loss. When, however, the pipe lines make no other connection than with the single point at the extremity of runs, such sources of loss are obviated.

A question scarcely secondary in importance to that of insulation refers to the most economic manner of transmitting a given quantity of heat from a central plant to a connected building. Other things being equal, the heat loss depends, first, on the extent of surface yielding heat, and, second, on the elevation of temperature of that surface above that of ambient air and of the adjacent surfaces to which heat is radiated. Because the surfaces of pipes of any given length vary directly as their diameters, therefore, for any given difference between temperatures of pipes and of surroundings, the smaller the pipes the less the heat loss becomes. In the case of delivering any fixed quantity of steam through small pipes the gain obtainable by diminishing the pipe size is partially offset by the high pressure, and the high pressure of the steam is required to convey an equal heat quantity in an equal time interval through the smaller pipe.

The usual and commonly the better method of supplying steam through long pipes for heating purposes is by the use of small pipes and high steam velocities, the latter being obtained by maintaining a large pressure difference between the supply and the delivery ends of such pipes. The necessary reduction in steam pressure is effected in part by the friction of flow through the pipes, that friction varying with the demand for steam. Instead of using a 10-in. pipe and 1-lb. (or 2.3-ft. water-column) pressure difference between ends, a 5-in. pipe and 30-lb. pressure difference, or even a 4-in. pipe and 91-lb. pressure difference, may be and generally is used.

High and fluctuating pressures and temperatures, with corresponding expansion and contraction, and resulting strains on piping and fittings and effects on the durability and life of the pipe system, are largely obviated by the use of water at a constant pressure and having relatively small variation in temperature.

Aside, therefore, from the important considerations of thermal economy in the operation of a combined power and heating plant, which have been shown to favor the use of water, are those of minor value affecting the durability and continuous intactness of the means of heat distribution which also favor its use.

If steam is used for heat or power transmission, for the protection of the piping against damaging strains, it is advisable, if not necessary, to maintain the temperature and pressure of the steam within the mains at as nearly a constant as is feasible. The heat loss is then continuous, and the rate is that of a high maximum average throughout the year.

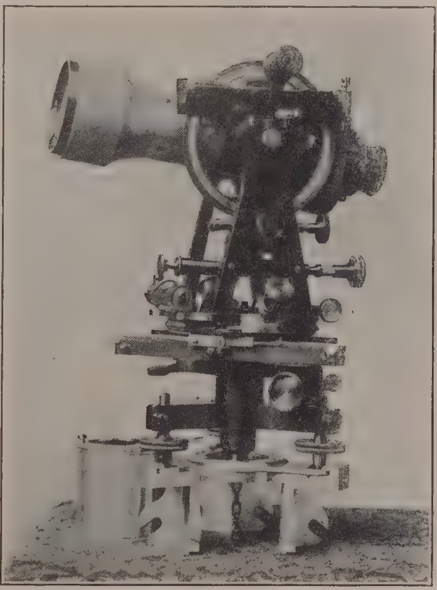
In the case of electric cables for power transmission, the carrying capacity of the cables is fixed by the size of the cables for a maximum per cent. of loss under the highest probable load. With power loads the resistance drops, and with that dropping the energy loss is reduced. Hence the percentage of thermal loss with the use of steam would largely exceed that of the electrical loss. That fact, therefore, makes against the transmission of power by steam rather than by cable; since the heat loss attending the use of steam is continuous, whatever the engine work, while the electrical loss varies with the load and becomes nil with no load.

If power is supplied to buildings by electrical current then heat may be transmitted by water, and through as small pipes as are required for steam when supplied and under pressures required for operating engines. The required head to produce water flow through such pipes may be maintained without waste of steam, heat, or power; the water temperature can be reduced to a point which shall make condensing work by engines possible and profitable; the exhaust steam of engines generating electric power can be converted into heat in the water; the lower the temperature of the water extracting heat from the steam, whether exhaust or live, the larger the proportion of the heat extracted from the steam, the boiler economizers making good to the condensed exhaust the heat given to the water before return to boilers; the total representing a gain in fuel, for exhaust and live steam, of about 7 per cent.

An objection to be made to the method of furnishing power and heat to the suppositive building from a central station is that which relates to the cost of and space occupied by the larger area of heating surface required in the building itself for imparting the necessary heat to it when the temperature of the radiating surface is as low as the assumed conditions would make it.

The cost of a heating installation within a building in which low-temperature water is used, and in which the water is mechanically circulated, exceeds the cost of a plant of equal power adapted to low-pressure steam only in radiating surface, and not in piping and fittings.

If with steam the average heat yielded is 270 t.u. per square foot per hour, the yield by water at 150° would be approximately 160 t.u. The excess of surface for water over steam would therefore be 70 per cent. If the aggregate surface is compared on a 300 b.h.p. basis, and on the assumption that one-third of the heat is yielded by direct radiation and two-thirds by indirect to air for ventilating work, the direct radiation would approximate, for steam, 10,700 sq. ft., and for water, 18,000; and the indirect, for steam, 4,330, and for water, 8,660 sq. ft. The excess on the side of water would be 7,300 for direct and 4,330 for indirect; a total of 11,630 sq. ft., at a cost of $3,500, and an interest cost at (2 per cent. rate) of $70 per annum. That amount would be many times saved by the employment of the economies obtainable by the use of water properly adapted to the particular conditions of the case.



Transit Used with Camera.

Direct-Connected Transformers, that is, each transformer receiving directly the current from the corresponding generating unit without any intervening switches, constitutes one of the features of the water-power plant at Gromo, Italy, of the 40,000-volt transmission system to Nembro, 22 miles distant. There are three 1,000-h.p. turbine-generator-transformer units, including Escher-Wyss turbines, and the switches to effect parallel operation are located in the 40,000-volt circuits.

Photographic Methods on the Canadian Topographical Survey.

At the International Geographical Congress held a few months ago, Mr. Arthur O. Wheeler, F.R.G.S., topographer of the Canadian Department of the Interior, exhibited a photograph of a map of the portion of the Selkirk Mountains adjacent to the Canadian Pacific Ry., together with enlargements of some of the views taken for the purpose of plotting the map. On this map the mountain topography is shown by 100-ft. contour lines located by data obtained photographically from camera stations, except on the line of the railway and for some minor details. The method of carrying on this survey was so interesting that it is proposed to give in this article an abstract of Mr. Wheeler's paper before the Congress explaining the map and views which he exhibited there.

In all photographical surveying it is essential that the features to be mapped can be seen in at least two views taken from stations some distance apart and at known positions and elevations. The two stations and the point to be projected should form a fairly well-conditioned triangle. On the plan the points are placed in position by projecting on it the traces of the horizon and principal lines for the two or more views, and the lines of sight from each camera station to these points. The traces of the horizontal and principal lines are required for plotting these lines of direction. By inserting needles at the camera stations and using a fine silk thread, or, better still, a long human hair, the work is made mechanical and can be performed through a series of points very rapidly.

A sufficient number of points along the ridges of the area to be mapped are determined from the photographs to enable the topography to be plotted with the desired accuracy. The elevations of these points are based upon the elevations of the points from which the views were taken and are obtained directly from the photographs. The horizontal line of a view corresponds to the altitude of the station. The elevation of any point in the photograph is proportional to its height above or below the horizon line, and the distance that its projection falls within or beyond the trace of the horizon line.

The general method of taking topography with a camera is similar to that of the plane-table, with some minor exceptions. With the plane-table, for example, most of the plotting is done in the field, while with the camera the same work is done in the office; with the plane-table it is possible to occupy but one station at a time, while with the camera, in plotting, both stations can be occupied at once, because both pictures of the same feature are before the map draftsman at the same time. This is a very strong factor in the identification of points, but on the other hand the most perfect photographs are but weak representations of nature's contrasts.

To fix camera stations in position four methods may be adopted: (1) If close to a triangulation station, by taking at the station the azimuth from another primary or secondary point and measuring the distance with a tape; this is the easiest and most accurate method. (2) If distant from a triangulation station or an independent summit, by erecting a signal and reading upon it with a transit or theodolite from outside fixed points. (3) By taking one reading upon it from an outside fixed point and at the station two readings on other fixed points. (4) By taking four or more readings at the station on outside fixed points. In the third and fourth methods the readings are plotted on tracing paper and lines drawn in the directions obtained. The paper is then shifted around until each line passes through the station to which it belongs. The point from which the lines radiate is then at the location of the station to be fixed and may be pricked through. The last method is particularly useful in the absence of any organized system of triangulation, when the work is of an exploratory nature.

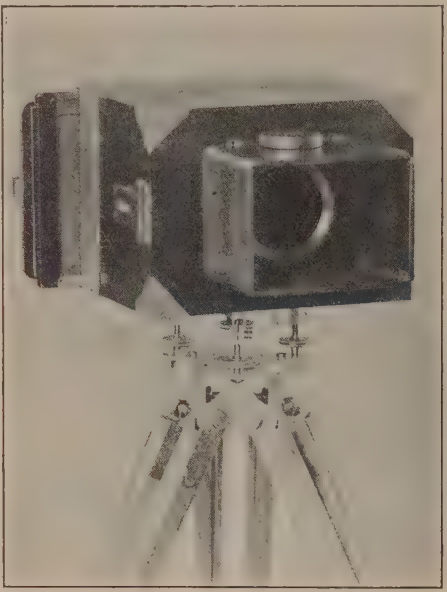
The topography of the Selkirk Range taken by the use of the camera has been mapped on scales of 1:60,000 and 1:190,080. It covers about 1,100 square miles of the wildest and roughest portion of the mountains. Field work was begun early in July, 1901, at Albert Canyon. Signals were set on the surrounding mountains and at intervals along the railway, and readings and photographic views were taken from each or from suitable camera stations closely adjacent. The work was expanded westward on both sides of the railway to the Columbia valley, where a five-mile tangent on the Arrow Lakes branch line offered a suitable base. About the middle of August it was found necessary to leave the valley on account of the smoke from forest fires, and work was accordingly taken up on the summit of the range and produced westward to tie with that begun at Albert Canyon. The field work was closed at the end of October. During the next year, 1902, the survey was extended northward and southward of Rogers Pass, and was begun about the end of July and finished about the end of October. The field work thus occupied, all told, about seven months, during which period considerable time was lost owing to the dense smoke from fires, as well as from cloudy and wet weather.

The line and elevations of the railway were used as references for geographical position and altitude. Trigonometric levels were employed for altitude work. The distance between camera stations was from 1 to 10 miles, averaging about 5 miles. The field work was carried on by a party of six, including Mr. Wheeler, two assistants, two packers, and a cook. The transport was chiefly by pack ponies, although at places it was necessary to carry the outfits on the backs of the party. The work of carrying the instruments to the summits was frequently attended with considerable danger, where treacherous deeply-crevassed snow fields had to be crossed, ice slopes scaled, and beds of snow traversed at places where an avalanche might occur at any time. To look into deep gorges and obtain working views, overhanging ledges and rock crags had to be occupied where barely sufficient room could be found to set up the instruments, and great care was required in moving around them. In all 64 ascents were made, the altitudes ranging from 1,490 to 11,113 ft. above the sea level; 120 camera stations were occupied, as many as three being placed on one peak. The views taken were 765 in number, and the same number of bromide enlargements were made. Some of the plates were duplicates taken at different exposures for different parts of the view, for the purpose of ascertaining how the photography was going. It was found that the time and material spent in taking a few extra views were often of the greatest benefit, for data missing at some particular station may be found obtainable from another in this manner.

The office work, which was done by Mr. Wheeler and his two assistants, comprised the development of the plates, making bromide enlargements from the negatives for plotting prints, the computation and plotting of the control system and camera stations, the taking out of relative elevations, the projection of the plan of the points selected for contouring with their elevation above datum, the drawing of the contours and the inking of the map. In the original draft the contours are shown in brown, the water courses and permanent bodies of ice and snow in blue, the timber in green, the roads and town sites in red, and all lettering and other features in black.

The actual time employed in this work was 14½ months. The total cost is summarized by Mr. Wheeler as follows: Area mapped, 1,113 square miles; cost of field work, $5,073.74; cost of office work, $4,395.60; cost of material, $120; total cost, $9,589.34; cost per square mile, $8.61.

The instruments employed in this survey were designed by Mr. E. Deville, surveyor-general of the Dominion Lands, and comprised a short, stout tripod on which either a plain fixed-focus camera or an ordinary transit-theodolite could be mounted. The transit had a 3-in. circle reading to minutes, with a vertical circle attached to the telescope. The tripod was 3 ft. 4 in. long and had sliding legs by which its length could be reduced to 20 in. It was packed in the outer case of the transit box. The camera was an oblong metal box open at one end, which fitted into an outside wooden case. Cross levels were attached to the metal box in two positions, the longer of which was called the "horizontal" and the shorter the "vertical." Plates were used, for films were found to be subject to distortion when passing through the developing process. Each plate was carried in a single holder, the outer case of the camera being fitted with a box to contain a dozen. Foot screws were fitted to the lower side of the camera in either position, permitting it to be accurately leveled. The reading of the levels to secure a vertical position of the plates is a rather delicate operation which calls for some skill and was executed before commencing the survey. The focal length of the camera was marked on the edge of the metal box, against which the plate pressed and was registered on every view taken; consequently it appeared on each working print. The lens was a Zeiss astigmat, No. 3 of series V, the aperture F/18, and the focus 141 mm.; a deep orange screen was used in front. With a medium-speed isochromatic plate the unit of exposure varied from 15 to 25 seconds. The plates were 6.5 by 4.75 in., and furnished bromide enlargements for plotting purposes of about 10x14 in. In the horizontal position the lens covered about 56 deg. of arc, and seven plates were required to complete a circuit, allowing for overlap. In the vertical position the lens covered about 37 deg. of arc, and eleven plates were required.



Camera for Topographical Surveys.

Some interesting data concerning the accuracy of the photographic method of taking topography were mentioned by Mr. Wheeler. While conducting the survey a series of views were taken from commanding points in the Selkirk district from which a number of the highest peaks of the adjacent Rocky Mountain range were visible; among these Mts. Columbia, Bryce, Lyell and Forbes were easily identified. Having plotted the Selkirk triangulation, it was attempted, as a matter of experiment, to compute from the photographs the altitudes of these summits. The methods employed were those used in the ordinary reduction of altitudes for points for contouring; the positions of the peaks were first laid down from the photographs and the distances scaled, the differences in elevation were next computed, and a correction applied for curvature and refraction. In the case of Chancellor Peak, the altitude had been previously established by the Topographical Survey from a series of angular readings as 10,780 ft. From four photographic views it was figured as 10,751 ft. The mean distance from the photographic stations to this peak was 45 miles. In the case of Mt. Columbia, two previous barometric determinations gave the height at 12,500 ft.; the mean of four photographic determinations was 12,725 ft. Two barometric measurements of the height of Mt. Bryce were 12,000 ft. and 11,800 ft., respectively; the mean of six measurements from photographs was 11,685. Two barometric measurements of Mt. Lyell gave 11,500 and 11,900 ft., respectively; the mean of four photographic measurements was 11,459 ft. Mt. Forbes was given as 12,000 and 12,500 ft. high by two barometric measurements, while the mean of four photographic measurements was 12,069 ft. In each case the extreme distance between camera stations was a little over 18 miles. The average distance between Mt. Forbes and the stations was 50 miles, between Mt. Lyell and the stations 52 miles, between Mt. Bryce and the stations 58 miles, and between Mt. Columbia and the stations about 62 miles. The barometric readings mentioned were not taken by Mr. Wheeler's party, who worked out the elevations wholly from the photographs.

One of the most interesting sections of Mr. Wheeler's paper related to the special fields in which photographic methods are most serviceable. While they are undoubtedly suited to the delineation of highly accented topographic areas, where an accurate system of control has been extended, they are particularly suited for quick reconnaissance surveys and geographical explorations. Such explorations are frequently carried up the valleys of main waterways and extended over important lake basins. This is usually accomplished by some form of traverse, using magnetic bearings for direction and the rate of travel for reckoning distance, checked by astronomical observations for latitude, and either astronomical observations or chronometer reckoning for longitude. Altitudes are generally obtained by means of barometric levels. In such cases, Mr. Wheeler believes photography can be substituted with great advantage. By carrying a quick triangulation up a river valley or spreading it over a lake basin or other area, a more rapid and accurate result can be obtained, provided there are points of sufficient altitude bounding or within the area to display it in detail to the camera. A strong point in its favor is that the altitude is carried by angles of depression and elevation from point to point, read back and forth between stations, and all others are taken from the views.

There are three special constructions applicable in explorations, to which Mr. Wheeler called attention.

First Case.—The method of squares is particularly applicable to the delineation of rivers flowing through wide bottoms which may be heavily timbered and inaccessible to travel except on the waterway itself. Here, from the surrounding heights of the valley, a bird's-eye view can be obtained, where all the windings and side channels, islands and other details are displayed as on a map. The perspective of a series of squares is now drawn upon the photographic view covering any section of the stream and a corresponding series of squares drawn in proper position on the plan. The channels, islands and other features are then drawn in at sight, square by square. It will be seen that such a system of delineation could not be obtained by ordinary methods of traverse except at great expenditure of time and money, as it would be impracticable to follow every channel or to delineate every island.

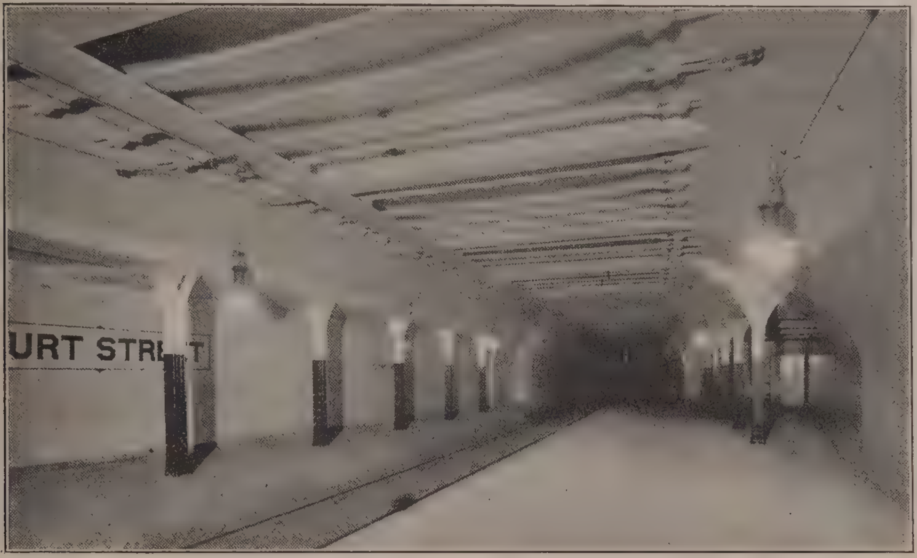
The same construction applies to any lake or series of lakes by connecting camera stations around their basins. The plane-table is generally used for such surveys, entailing a large amount of map construction in the field. By the photographic method the map work can be done entirely in the office on the explorer's return.

Second Case.—A second construction is specially adapted to the configuration of topographical features lying in planes practically parallel to the horizon plane of the camera station, such as lakes, stretches of coast line, swamps with streams winding through them, salt marshes and prairie openings in timbered areas. It is only necessary to know the altitude of the camera station and the altitude of the plane in which the feature lies. With these data, the delineation can be made from a single view of such portion as can be covered from it.

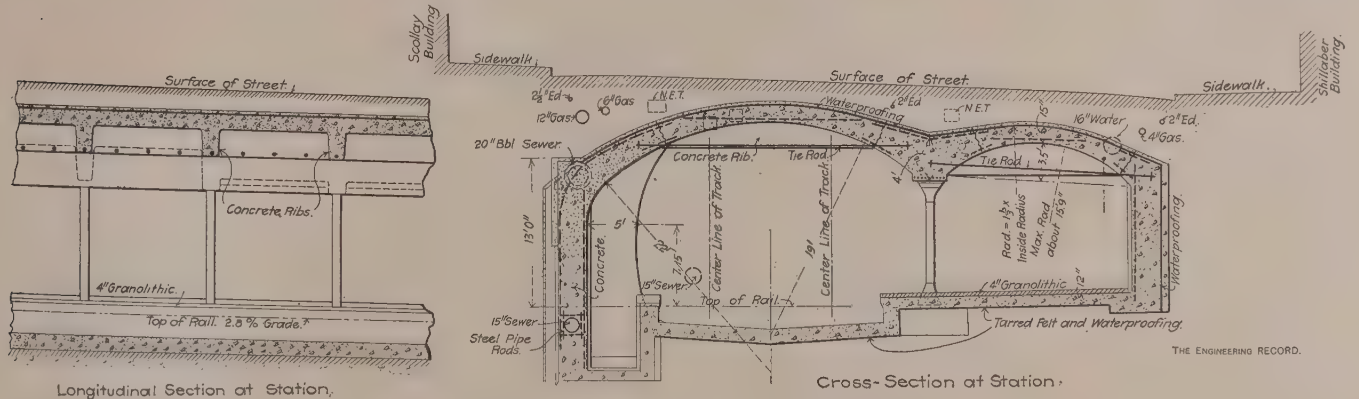
Having selected in the view a sufficient number of points to enable the feature to be sketched, the traces of the horizon and the principal lines of the view are laid down on the plan. The points selected are projected on the trace of the horizon line, and lines are drawn to them from the camera station. To the right or left and parallel to the principal line, a line is drawn at a distance equal to the difference in elevation of the camera station and the plane of the feature to be drawn. The distances of the respective points below the horizon line of the view are now laid off on this line, measuring from the trace of the horizon line on the plan, and lines drawn through them parallel to this trace. Their intersections with the lines previously drawn from the camera station to the several projections of the points of the trace of the horizon line establish the relative positions of the points on the plan, and the bounding lines of the feature to be mapped can be drawn through them at sight.

The same results can be achieved by the method of squares, but it would then be necessary to obtain a new ground plane for each view of the series; whereas, in the present case, once the altitude of the plane parallel to the horizon plane of the camera station is found, it applies throughout the series.

Third Case.—Another feature in conjunction with the conduct of an exploration survey by photographic methods is the facility it affords to ascertain the altitude of surrounding peaks in mountainous or semi-mountainous country with a considerable degree of accuracy. The determinations of the heights of Mts. Chancellor, Columbia, Bryce, Lyell and Forbes, already mentioned, are instances of this class of work which is possible with the camera.



Special Concrete Subway Construction at Station.



Longitudinal Section at Station. Cross-Section at Station.

Ribbed Concrete Arch Subway Construction.

A Concrete Subway Roof Arch with Reinforced Ribs.

In section F of the East Boston tunnel, the subway on Court St. widens opposite the Old Court House, to a station with platforms on both sides of the double track, but not directly opposite. The concrete roof over the tracks and station platforms is made in two continuous segmental arch spans supported on the side walls, with which it is integral, and on a line of steel columns about 12 ft. apart near the outer edge of the platform. The tops of the columns have extended caps supporting a mass of concrete about 48 in. high and 36 in. wide, which serves for the continuous skewback for the arches and is reinforced with nine ⅞-in. Ransome steel rods close to the lower edge, to give it strength to act as a longitudinal girder between columns. The concrete at the skewbacks was laid up with the side walls for some distance beyond their inner faces, and was laid about 5 ft. wide each side of the center of the line of columns, before the arches were completed, by laying the concrete in the centers of the spans. The joints between these successive sections were bonded by steel splice bars about 3 ft. long, built into both portions, as shown in the cross-section, and the arches were reinforced by horizontal ⅞-in. Ransome transverse rods 12 in. apart. The lateral thrust was provided for by tie rods 2 ft. 3 in. apart longitudinally. Over the tracks these rods are horizontal, but over the platforms they are slightly inclined so as to bring their upper ends nearer the centers of the longitudinal beams than if they were horizontal. Each tie is composed of a 2-in. square bar center section about 16½ ft. long, with a clevis at each end, having its pin engaging the loop of a U-shape 1½-in. square bar built into the concrete and having the ends anchored by nuts and washers, while the loops project a few inches beyond the arch soffit near the haunches. Every fifth tie is enclosed in the lower part of a solid concrete rib, which is about 15 in. wide and has a horizontal lower edge 28 in. below the arch soffit at the crown.

The questions of direction and depth and general conditions at this station were a long time in doubt, owing to circumstances over which the engineering department had no control. When these questions were determined it was desirable to make the construction with as little delay as posible. The materials in the particular design could be had more promptly than the usual steel girder and beam construction. With prices prevailing at the time it was considered at least as economical. The motive for the concrete rib was to provide against distortion of the arch from unequally distributed loading.

The tunnel was designed and constructed under the direction of the Boston Transit Commission, Mr. Howard A. Carson, chief engineer, and Coleman Brothers, contractors for section F.

Letters to the Editor.

Areas of Circular Segments.

Sir: In the preparation of final estimates for concrete masonry excavation, etc., in connection with works of large magnitude, it very frequently happens that the areas and lengths of arcs of circular segments of a variety of chords and mid-ordinates must be obtained. The usual method of obtaining these quantities, especially the areas of segments, is laborious. It involves the computation of the radius, the central angle, the area of the sector, and the corresponding triangle, and the difference between the sector and the triangle equals the area of the segment.

Trautwine gives a table of areas of segments. But, when the chord and mid-ordinate alone are known, as is frequently the case, the use of this table consumes considerable time. The diameter must first of all be obtained by the formula,

$$D = \frac{s^2}{4\,r} + r$$

in which D is the diameter, s the chord, and r the mid-ordinate. The mid-ordinate must then be divided by the diameter; the table gives for this ratio a factor which must be multiplied by the square of the diameter to obtain the area of the segment.

In the hand-book of the "Verein Hütte," there is a table of lengths of arcs, mid-ordinates, chord lengths, and areas of segments for circles of unit radius corresponding to any central angle. In order to use this table, it is therefore necessary to compute the radius and the central angle from the chord and mid-ordinate.

For facility of computation, two tables have been prepared, one for areas of segments and the other for lengths of arcs. In one column the ratio of the mid-ordinate to the chord is given; and in the adjacent column, the corresponding value of c. To obtain the area of the segment, the product of the mid-ordinate and chord is to be multiplied by c, obtained from the table. More time is saved by the use of the table of areas of segments, and this table is therefore given.

Areas of Segments of Circles.
Span or chord = s
Rise or mid-ordinate = r
Area = c r s

r/s.	c.	r/s.	c.	r/s.	c.
0.01	0.6667	0.18	0.6836	0.35	0.7280
.02	.6669	.19	.6855	.36	.7313
.03	.6671	.20	.6875	.37	.7347
.04	.6675	.21	.6896	.38	.7382
.05	.6680	.22	.6918	.39	.7418
.06	.6686	.23	.6941	40	.7455
.07	.6693	.24	.6965	.41	.7493
.08	.6701	.25	.6989	.42	.7531
.09	.6710	.26	.7014	.43	.7569
.10	.6720	.27	.7040	.44	.7608
.11	.6731	.28	.7067	.45	.7648
.12	.6743	.29	.7095	.46	.7688
.13	.6756	.30	.7124	.47	.7729
.14	.6770	.31	.7154	.48	.7770
.15	.6785	.32	.7185	.49	.7812
.16	.6801	.33	.7216	.50	.7854
.17	.6818	.34	.7248		

As an illustration of its use the area of the segment being a chord of 3.9634 feet and a mid-ordinate of 1.5 ft. is computed.

s = 3.9634 ft. r = 1.5 ft.
r/s = 0.3785 log. = 9.578023

r = 1.5 log. = 0.176091
s = 3.9634 log. = 0.598068
c = 0.7377 log. = 9.867880

Area = 4.386 sq.ft. log. = 0.642039

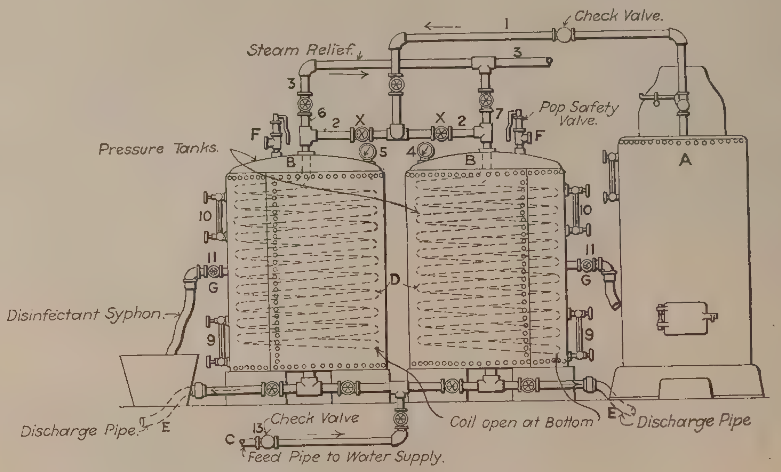
The above is submitted in the hope it may prove of benefit to some of your readers.

Yours truly, S. D. Bleich.

New York, Feb. 13.

Garbage Wagon Washer.

Sir:—The accompanying illustration of a garbage wagon washer designed by me for the use of the Street Department of St. Louis may be of interest to you. This apparatus is designed to wash 100 wagons daily. The washer and disinfector consists essentially of two pressure tanks connected with a water main and interchangeably connected with each other, so that while the water in one tank is being heated, the other tank can be in use. The steam supply is preferably taken from a small vertical boiler and passed through coils placed within the tanks, which coils are left open at the lower end, permitting the steam, after passing through the coils, to escape and pass up through the water, further heating it, and also furnishing the necessary pressure to dicharge the heated water, through the steam hose and attached nozzle, at any desired temperature and pressure, thus affording a quick and thorough means of cleaning wagons from garbage, offal, etc. It further affords means of disinfecting the wagons and refuse at but little additional trouble or expense. In case of emergency both tanks can be used at once, permitting two wagons to be washed and disinfected at the same time.



Apparatus for Washing Garbage Wagons in St. Louis.

The apparatus shown in the cut consists of a vertical boiler (A) connected with two pressure tanks (B), which are connected with a water main (C). The steam from the boiler is conveyed through the pipes 1, 2 and 3, to the tanks and through the coils (D), which are placed within the tanks. The steam escaping from the open end of the coil passes up through the water to the top of the tank, where it will show the desired pressure on the steam-pressure gauges 4 and 5, placed on top of the tanks, the regulation being by the valves X.

When all the water in the tank has been discharged through the hose (E), the tank will be filled with steam under pressure, which, by using the steam relief pipes 6 and 7, can be used again to heat the boiler-feed water. The level of the water while filling and emptying tanks is shown by the water-gauge glasses 9 and 10, placed at the top and bottom of the tanks. A safety valve (F) is placed on each tank as a precautionary measure. Through the opening (G) in each tank, the disinfectant to be used can be siphoned by opening the valve 11, while relieving the tank of steam. Check valves 12 and 13 are placed on the steam and water inlets, preventing release of steam or water in case the pressure should be too low, or suddenly decreased.

Using 15 lb. of steam pressure to the square inch, one wagon per minute can be cleaned and disinfected with this apparatus.

Very truly, Joseph G. Branch.

St. Louis, Feb. 8.

An Electric-Crane Power Plant.

An electric-crane power plant has been built by the London, Brighton & South Coast Railway Co., at Deptford Wharf on the River Thames, recent extensions carrying with them the decision to employ electric traveling cranes and to build a plant largely to furnish the current necessary. Accordingly, as described in "Engineering," a power installation is now in use containing two 200-h.p. 230-volt direct-current units, a pair of Babcock & Wilcox boilers fitted with B. & W. chain grate stokers and with superheaters and induced draft provided with a duplicate installation of centrifugal fans, each having a capacity of handling 11,700 cu. ft. of gas per minute at 450° temperature, or sufficient, it is stated, to create a draft of 2 in. of water. One fan is direct driven by a steam engine and the other by a motor. There is also a duplicate set of boiler-feed pumps, one steam actuated and the other of a three-throw type operated by an electric motor and fitted with a Sinclair variable stroke gearing, which allows the stroke of the plungers to be graduated from full stroke to zero while in action. The work was installed in accordance with recommendations of Mr. Philip Dawson, as consulting engineeer, by Messrs. Dick, Kerr & Co.

The Speed of Steam in Superheater Tubes ranges from 13 ft. to 92 ft. per second in present German practice, according to Mr. O. Berner in the "Zeitschrift" of the Society of German Engineers, of London. Below 32.5 ft. to 50 ft., however, the conditions appear unfavorable for the transfer of heat from the gases to the steam and also increases the rate of deterioration. The upper limit of speed is determined by the permissible drop in pressure in the superheater. For a steam pressure not under, say, 140 lb. per square inch, a drop of 3.5 to 4.2 lb. pressure is stated as being permissible; for lower pressures the drop, it is added, should not exceed 2.8 to 3.5 lb. per square inch. In speaking of the materials of construction of steam superheaters he gave figures for six installations employing cast-iron superheaters of the Schwoerer type. The average yearly expenditure per superheater for repairs was $16.21, or 27.3 cents per foot of length of each element of the superheater.

CURRENT NEWS SUPPLEMENT

FEBRUARY 18, 1905.

ECTORY OF NATIONAL ENGINEERING SOCIETIES.

ERICAN SOCIETY OF CIVIL ENGINEERS. tary, Chas. Warren Hunt, 220 West 57th New York. Next meeting, New York, h 1, 8.30 P. M.; paper by S. Waters on methods of river improvement, as de- ed on the Missouri River from 1876 to

ERICAN SOCIETY OF MECHANICAL ENGI- S. Secretary, F. R. Hutton, 12 West 31st New York.

ERICAN INSTITUTE OF ELECTRICAL ENGI- S. Secretary, Ralph W. Pope, 95 Liberty New York. Next meeting, New York, 24; papers by A. B. Herrick, on "Track es," and by N. M. Crawford on "Two- r versus Four-Motor Equipments."

ERICAN INSTITUTE OF MINING ENGI- S. Secretary, R. W. Raymond, 99 John New York.

ERICAN INSTITUTE OF ARCHITECTS. etary, Glenn Brown, Washington, D. C.

SOCIATION OF ENGINEERING SOCIETIES. etary, John C. Trautwine, Jr., 257 South th St., Philadelphia, Pa.

ERICAN SOCIETY OF HEATING AND VENTI- NG ENGINEERS. Secretary, W. M. Mackay, Water St., New York.

NADIAN SOCIETY OF CIVIL ENGINEERS. etary, Clement H. McLeod, 877 Dorchester Montreal.

CIETY FOR THE PROMOTION OF ENGINEER- EDUCATION. Secretary, Prof. M. S. chum, University of Colorado, Boulder,

ERICAN SOCIETY FOR TESTING MATE- S. Secretary, Prof. Edgar Marburg, Uni- ity of Pennsylvania, Philadelphia, Pa.

ERICAN SOCIETY OF MUNICIPAL IM- VEMENTS. Secretary, George W. Tillson, m 12, Municipal Building, Brooklyn, N. Y.

SOCIATION OF RAILWAY SUPERINTENDENTS BRIDGES AND BUILDINGS. Secretary, S. F. erson, Concord, N. H.

MERICAN RAILWAY ENGINEERING AND NTENANCE OF WAY ASSOCIATION. Secre- , L. C. Fritch, 1562 Monadnock Block. cago. Annual meeting at Chicago, March 22 and 23.

MERICAN WATER-WORKS ASSOCIATION. Sec- ary, J. M. Diven, Elmira, N. Y.

MERICAN FOUNDRYMEN'S ASSOCIATION. retary, Richard Moldenke, P. O. Box 432, York.

NGINE BUILDERS' ASSOCIATION OF THE ITED STATES. Secretary, J. L. Lyle, 39 tlandt St., New York.

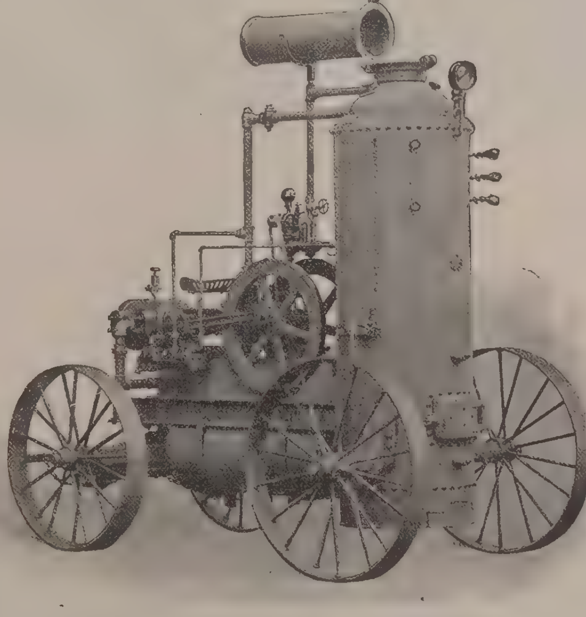
PIKE'S PEAK POLYTECHNIC SOCIETY.

his society, organized last November at orado Springs, is composed of civil engi- rs and surveyors, mining, mechanical and ctrical engineers, architects, irrigation and estry engineers, geologists, assayers, chem- and others who are studying or practic- along technical lines. Its object is the motion of intercourse, observation and ords in technical subjects, by means of iodical meetings, reading of papers, dis- sions, special investigation into matters public and technical interest, the publica- of such parts of the proceedings as should deemed expedient, providing the conven- ce of a library and reading room for its mbers and the collection of books and iodicals on technical subjects. It is also intention to secure the services of prom- nt specialists in various technical branches resented by the society, to lecture before members and invited guests. The regu- meetings are held on the second Saturday each month in the society's rooms in burn Libary on the Colorado College cam- s. The annual dues for resident members $5 and for non-resident members, $3; ere are at present, 80 members in good nding.

he following officers will serve for the ar 1905: President, William Strieby; Vice- esidents, B. H. Bryant, L. E. Curtis, W. F. uglas; Recording Secretary, E. A. Sawyer; rresponding Secretary, W. D. Waltman; easurer, Ira A. Miller. The following lectures have already been delivered before the society: Notes on Lightning, Prof. J. C. Shedd; The Guanajuato Power Plant, Mr. L. E. Curtis; General Subject of Forestry, Prof. W. G. M. Stone; The Panama Canal, Prof. J. H. Kerr; Chicago's Transportation Problem, Mr. Bion J. Arnold; Underground Waters, discussion led by Mr. E. C. van Diest and Prof. J. H. Kerr; The Forestry Movement, Mr. Clyde Leavitt; French Architecture, 8th to 14th Century, Mr. Nicolaas van den Arend.

PORTABLE BOILERS AND AIR COMPRESSORS.

There is a demand in many industries for a portable air-compressing outfit which can easily be carried from one location to another and used for operation of drills, chipping and riveting tools, sand blasting and similar purposes. The outfit illustrated herewith has been designed by the Clayton Air Compressor Works, of 114 Liberty St., New York City. It is entirely self-contained, as the boiler, compressed air receiver, air compressor, and circulating pump for cooling the air-cylinder jackets are all mounted on one truck. For riveting hammers the compressor is proportioned to deliver air at about 100 lb. pressure per square inch, while for sand blasting and stone tools, air is supplied at 70 lb. pressure. The receiver permits the storing of air so that a much larger number of tools may be operated than otherwise, since it is only occasionally that all tools are in operation at the same time. The pressure of the air is maintained by a pressure governor, while the compressor is prohibited from running away, in case of a break on the air line, by a fly-ball speed governor, the two governors being so combined that they operate upon a common throttle valve. The compressor engine exhausts into the stack, thus increasing the draught. The air compressor cylinder walls are jacketed and are supplied with cooling water by a small duplex pump.



CLAYTON PORTABLE BOILER AND AIR COMPRESSOR.

The special vacuum steam pumps, quick cleaning strainers and foot valves for suction pipes made by the Emerson Steam Pump Co., Alexandria, Va., are described in its 1905 catalogue. Detailed explanations are given of the construction, methods and economy of operation and the various purposes to which these pumps are particularly adapted, as pumping muddy water or water containing much grit, like that encountered in emptying cofferdams, sinking mine shafts, etc., and in work where a portable pump which can easily be installed and quickly removed is required. Similar descriptions of the strainers and foot valves manufactured by the company are also given.

CONCRETE SPECIALISTS.

The position to which concrete construction has now advanced is well shown by the work done in 1904 by a single firm of concrete specialists, the Rudolph S. Blome Co., of Chicago. The most interesting work executed this season was eight concrete buildings erected for the South Park Commissioners, the foundations, walls, partitions and floors being constructed entirely of concrete. The cost of these improvements will aggregate $210,000. Of contracts for foundations and substructures the most important were those of the Union Electric Co. power-house at Dubuque, Ia., at about $12,000; the National Enameling & Stamping Co. building, at 27 Kinzie St., at about $11,000; railroad substructure of the Chicago & Milwaukee Electric Railroad, at Rondout, Ill., Highwood, Ill., and Lake Bluff, Ill., at about $34,000; for the Chicago & Western Indiana Railroad Co., at Hawthorne, Ill., at about $12,000; a concrete dock wall for the Grand Trunk Railroad Co., at Grand Rapids, Mich., at about $30,000; a concrete subway and trestle foundations at the Western Electric Co.'s new plant, at about $16,000.

They built the concrete fireproof floors and roofs of the American Malting plant at Milwaukee, at $48,000; also of the Schlitz Brewing Co. malt-house at that city, at $24,000; of the boiler-house No. 2, the power-house and the hog-hair building at Armour Glue Works, aggregating $13,000; of the Armour & Co. plant at Sioux City, Ia., at $11,000; 110,000 sq. ft. of such floors and roofs at the Kansas City (Kan.) plant of Nelson Morris & Co.; the fireproof floors, roofs and stairways of the Metropolitan Elevated Railroad stations at Fifth Ave., Center Ave. and Laflin St., Chicago.

Among the more important office buildings, they executed the concrete work of Thomas Orchestra Hall, Chicago & Northwestern office building, Rector building, Railway Exchange, 140,000 ft. of concrete floors in the Patten building at Sherman and Harrison Sts., also the Rockefeller building at Cleveland, Ohio. They are laying the cement floors of the Indianapolis new postoffice and 90,000 ft. of cement floors for Nelson Morris & Co., and have contract for the concrete work of the Majestic Theater, at about $14,000. They also laid the cement floors of four large stables for The Fair and two for the Bowman Dairy Co., at $12,000, in Chicago.

Aside from numerous smaller contracts for cement sidewalks, the more important ones executed this year are 520,000 ft. at Salt Lake City, at a cost of nearly $100,000; 180,000 ft. at Kewanee, Ill.; 60,000 ft. at Cambridge, Ill.; 40,000 ft. at Wyoming, Ill.; 90,000 ft. at Waukegan, Ill.; 85,000 feet of cement and brick walls at the Indianapolis new post-office; walks at Whiting, Ind., at about $15,000; walks at five parks for the South Park Commissioners, this city, aggregating 310,000 feet; also some 30,000 feet at the Hinckley subdivision on Milwauke Ave. They also laid a concrete pavement on Willard St., Kewanee, Ill., and are laying some 100,000 square feet of similar pavement at the Western Electric Co.'s new plant at Hawthorne.

This concern has just been awarded, at about $110,000, what constitutes the largest contract ever let in Chicago for concrete fireproof floor construction, that of the Armour Glue Works' new soap plant, and they also hold contract to lay upward of a million feet of concrete floors, sidewalks and pavements of the new union station at Washington, D. C.

Having already booked nearly $500,000 worth of business for 1905, and as prospects indicate great activity in the building line, they look forward to an extremely busy coming season.

REVIEW OF AMERICAN ENGINEERING BY SIR WM. H. WHITE.

FROM LONDON LETTER IN THE NEW YORK TRIBUNE.

As an exiled American, very proud of my own country, yet discreet enough to prefer to have foreigners blow the trumpets for her, I have had a happy hour this week at the Institute of Civil Engineers, where Sir William White described in the handsome assembly hall the recent visit of the British delegation of engineers to the United States. The hall was crowded with members, and every tribute to American energy and hospitality was received with hearty applause; and when the great naval architect referred with admiration and enthusiasm to the marvels of engineering in and around New York it was fortunate that the lights were turned down, for the sake of the lantern slides, else I would have been betrayed in my place as a triumphant Yankee, exultant and unabashed! It was an informal and unpretentious record of the experiences and impressions of the British engineers who crossed the Atlantic last autumn and took an active part in the congress at St. Louis, after inspecting the subway, bridges, river tunnels, skyscrapers and Croton Dam in Greater New York and making flying excursons to Canada, Chicago and the Great Lakes; but the note of sincerity and good feeling vibrated through it, and every expression of grateful appreciation was caught up by the members, who knew how kindly their representatives had been received in America, and how much they had seen to inspire them with respect for the many mighty engineering works of their colleagues across the seas. Americans are in the habit of saying that Westminster Abbey. Shakespeare and all the noble traditions of English history and literature belong to them as much as to the insular Britons. These English engineers have learned that the converse is also true; that their own mechanic art has been carried to the New World and that they themselves have a rightful share in the marvels of invention, enterprise and progressive spirit which have been accomplished there. Certainly it is a poor rule that does not work both ways. If Americans are allowed "to read their title clear" to the storied abbeys, picturesque castles and literary monuments in England, they cannot object with reason if British engineers take pride in the costly works of New York and Chicago, the waterways of the Great Lake Basin, the utilization of the power wasted at Niagara and Sault Ste. Marie and all the other wonders of American and Canadian engineering science.

Sir William White, while not an orator, is a fluent speaker, with an engineer's trained talent for clearness of line and a gift of his own for humorous comment and good natured pleasantry. If his American and Canadian entertainers could have listened to his graceful acknowledgments of their hospitality and kindness they would have been well rewarded for the pains taken to enable the visiting engineers to see all the sights and to get an adequate idea of the stupendous energies of capital, municipalities, designers and inventors in working out the problems of a new world and the modern era of electric power. New Yorkers especially would have been highly gratified if they could have heard this running commentary upon the lantern slide illustrations of the subway, the great bridges over the East River, the tunnels under the North River and the precautions taken to secure an abundant water supply for the American metropolis. All these great works he described with unrestrained enthusiasm, and as he counted their cost in millions he could hardly find words in which to express his wonderment over the faith of municipalities and the enterprise of Greater New York, where the genius of the engineers had overcome the obstacles of an unfavorable environment and enlarged the area available for a truly imperial centre of population. The sketches of the "sky-scrapers" were certainly less picturesque than Mr. Pennell's charming etchings at the New Gallery, and in some instances almost wantonly realistic; and while he gave an impressive account of the rapidity with which these mammoth structures were constructed, the enormous masses of capital invested in them and the number of people earning a livelihood under a single roof—ten thousand, for instance, in one of the largest Chicago buildings—he did not attempt to conceal his satisfaction that quaint, time-worn London had remained behind the times. He was even more conservative in his description of the Brooklyn Navy Yard, for he was not prepared, as the director of construction for the admiralty for a long period, to admit that the old country had been surpassed in the resources of sea power; but his face lighted up with a fine glow of pleasurable reminiscence when he recalled his visit to West Point, the courtesies of General Mills and the beauty of the scenery on the Hudson.

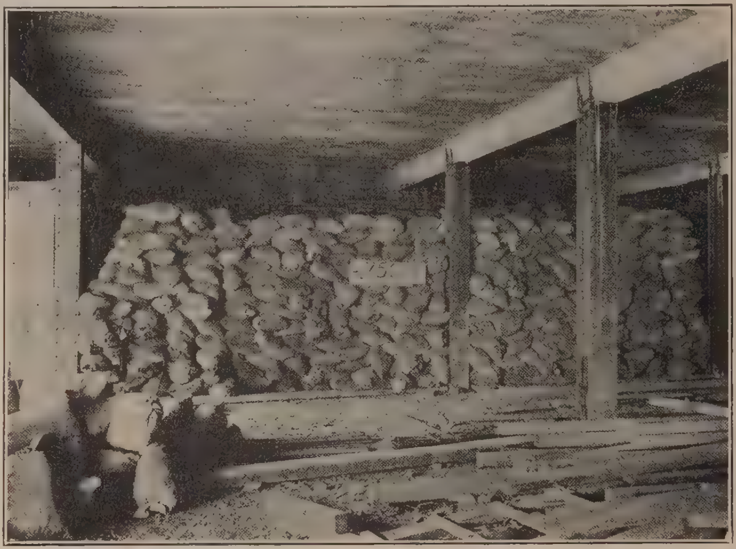
There was no lack of enthusiasm when Sir William White recounted the marvels of Canadian progress, illustrated the enormous commerce of the Sault, described the new railways and waterways of the Dominion, paid a glowing tribute to McGill University as one of the best equipped strongholds of modern learning and displayed a fine series of pictures of Montreal, Ottawa, Quebec and Toronto. He explained how formidable a force Canadian energy had become when the improvement of the waterways north of the border was forcing the State of New York to undertake a new enlargement of the Erie Canal, and he winged a rapid flight among the skycrapers and storage elevators of Chicago, and finally swooped down upon St. Louis and the exposition. Perhaps the most interesting passage of his address was his account of the new power generating works at Niagara, illustrated as it was with fine pictures on the screen, and containing an effective contrast between the first redskin who gazed with wonderment and awe at the majesty of the mighty cataract and the modern engineer who, while more sensitive to the scenic beauty of the flood in its onrush into the chasm, is chiefly concerned with the problem of wasted energy and the conversion of it into working power. The distance between that aboriginal and the electric engineer measured—in Sir William White's effective phrase—the entire sweep of the progress of civilization. More eloquent than any purely literary phrase was the fraternal spirit in which this great designer of the British navy referred to everything that was progressive in the engineering work of Americans and Canadians. There was not a trace of what Emerson once described as the habit of condescension in the compliments and eulogies showered upon transatlantic engineers. Sir William White had risen to the high level of Anglo-Saxon brotherhood, and with unaffected simplicity and sincerity he could speak without envy or jealousy of the wonderful achievements in engineering in America and Canada and claim his own heritage in the glory and renown of the English speaking world.

Pile-driving machinery is described at much length in a catalogue just issued by the Vulcan Iron Works, Chicago. The great variety of standard types of drivers that is revealed by this pamphlet is surprising, and some of the types, such as those built for driving fence posts, are decidedly novel. The Warrington steam hammer is explained in detail, and also a machine for cutting off piles under water. Useful information is furnished concerning hammers, turntables, nippers, trips, shoes, clamps, caps, followers and other fittings, and considerable data on the safe bearing loads for piles is given.

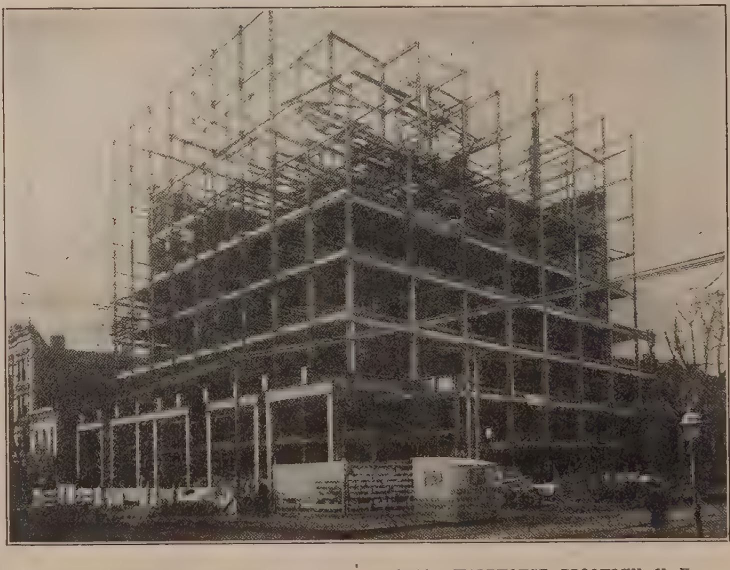
TEST OF A COLUMBIAN FLOOR.

The accompanying illustrations show the steelwork of the Long Island Storage Warehouse in Brooklyn, N. Y., and the weight put on a part of one of the floors to test its strength. The building was designed by Messrs. Helmle, Huberty & Hudswell, and gives an interesting example of Columbian floor construction. The building is 120x125 ft. in plan and 113 ft. high. The steel columns carry I-beam girders 15 ft. apart which are connected every 24 in. by 3½ in. Columbian ribbed bars, laid across their top flanges. These bars are put in place with the other steelwork, as shown in the progress view, and serve as bracing for the girders as well as reinforcement for the floors.

The floors are 5 in. thick, and made of 1:2:5 concrete with crushed furnace slag; this material is also used around the I-beam girders as a protection against fire. The ceilings will be painted with cold-water paint applied directly to the lower side of the floor slab without plaster.



ACCIDENTAL LOAD BROUGHT UPON COLUMBIAN FLOOR DURING CONSTRUCTION.



STEELWORK OF THE LONG ISLAND STORAGE WAREHOUSE, BROOKLYN, N. Y.

During construction two entire bays of the floor were accidentally loaded with cement, as shown in the illustration. The load was about 750 lb. per square foot, and produced a deflection of 1⅝ in. in one bay and ⅛ in. in the other. After the removal of the load the deflection decreased in the first bay to 1 in. and increased in the second to 5/16 in., but later recovery reduced the permanent set to ⅝ in. and 3/16 in. in the two bays. The floors were designed for a load of 120 lb. per square inch, with a factor of safety of four, in accordance with the system of the Columbian Fireproofing Co., New York.

The Goodsell Packing Co., 23 South Canal St., Chicago, Ill., have issued a new catalogue of various brands of sheet packing, gaskets, valves, etc.

STURGESS HYDRAULIC RELIEF VALVE.

The object of the Sturgess relief valve, illustrated herewith, is to relieve automatically the pressure on a closed pipe line operating water wheels when the gates of the latter are suddenly closed, either by accident or by the regular operation of the governor. The relief valve is designed to quickly open when the pressure in the penstock increases above that due to the static head, and to gradually close again as soon as the pressure in the penstock is restored to normal. By this means it not only protects the penstock against bursting, but improves the regulation by preventing an excessive amount of water passing to the wheels during the closing action of the gates.

Within a body having a funnel-shaped connection for attaching to the penstock is a relief valve having lignum vitæ seats, the face of the valve being exposed to the pressure in the penstock, so that it opens outwardly. The back of the valve is formed into a piston which works within a cylinder in the upper part of the body. A connection between the cylinder and the penstock is made through a valve.

An outlet from the cylinder is provided by a valve which is controlled by a small piston, working within a cylinder. The passages to this cylinder are controlled by a pilot valve, which is in turn controlled by a weighed diaphragm above, the diaphragm being in communication with the penstock pressure through other valves.

The valve is designed to work in conjunction with the Sturgess water-wheel governors, which have a tank containing oil under considerable pressure, the pressure being maintained by a pump. Oil from this tank is piped to the pilot valve to operate the control piston above referred to, the exhaus
ing led back to the pump.

In operation the counterweight is adju
so as just to overcome the outward pres
on the diaphragm due to the water pres
within. This causes the pilot valve to
raised just sufficiently to admit the oil
sure above the control piston, causing
hold the cylinder outlet valve down on
seat. The water from the penstock, flow
through fills the cylinder above the pens
valve and causes it to be held down on
seat, against the pressure in the penst
This is due to the greater area of the cyli
over the valve exposed to the water press

The pressure in the penstock now ri
due to the closing of the gates. This
crease of pressure is felt by the diaphr
which overcomes the balance weight,
causes the pilot valve to move sufficient
admit pressure beneath the piston.
raises the cylinder off its seat, relieving
water in the main cylinder. The valve
being unbalanced, is thrust open by the
acting on its exposed area and the disch
takes place, relieving the pressure in
penstock. As soon as the pressure is
lieved, however, the diaphragm will go
to its normal position reversing the move
of the piston so as to again close the cyli
valve. The water, which has been run
all the while through the penstock
now fills up the main cylinder as be
gradually closing the valve.

Two connections are made from the
phragm to the penstock through valves.
of these valves is connected to the pens
at a point close to the relief valve, where
velocity of the water is high, and the
one, to a more remote point of the pens
where the velocity of the water in the
stock is comparatively low. By part
opening both these valves to a varying
gree, the amount that the valve shall
for a given rise in pressure can be re
adjusted. The rate at which the valve
close again is adjusted by the penstock
For the purpose of closing the valve by
so as to enable any of the working par
be removed, a supplementary hand cl
gear is provided, consisting of a scr
stem geared to a hand wheel. The
when run down, holds the valve upon its
but when the valve is working the ste
drawn up out of the way.

The discharge from this valve shou
piped into the tail-race and sealed so
prevent freezing, and in order to get the
opening of the head available. As the
is thus piped away the relief valve ca
desired, be set in the generator room,
it will not be subject to severely low tem
tures, and thus the winter troubles, to
relief valves, will be avoided.

BUSINESS NOTES.

The Allis-Chalmers Co. is making i
tant changes in the organization of its
offices throughout the country. These ch
are brought about because of the broa
scope of the company's operations sin
acquired The Bullock Electric Mfg. C
Cincinnati, which has now become the
trical Department of the Allis-Chalmer
Hereafter, the rule will be that each
Chalmers district sales office will rep
all the company's lines of manufactu
prime movers, as well as in saw mill,
mill, mining, crushing, cement and othe
chinery and the electrical interests.
policy involves the opening of a consid
number of new Allis-Chalmers offices, a
many places the consolidation with the
the Bullock offices heretofore maintain
the same centers. Some recent ch
brought about by following this policy a
follows: An Allis-Chalmers district sal
fice has been opened in St. Louis in the
ical Bldg. The Bullock Electric Mfg.
pany's offices, formerly in the same bu
have been consolidated with them. H. F
formerly district manager for the B
Co., is the manager for the consolidat
fices. An Allis-Chalmers Co. district
office has been established in Clevela
the New England Bldg., where the B
offices formerly were, and the two office
been consolidated under the manageme
Franklin Wharton, formerly district ma
for the Bullock Co. A Bullock office ha
opened in the Frick Bldg. in Pittsbur
consolidated with the Allis-Chalmers
under the management of H. Wiedemar
ray, who has for years represented the
Chalmers Co. in that district. The
Chalmers Co. has established a new o
Kansas City in the Dwight Bldg. Geo

ı, who has been connected with the
for a considerable time in other ca-
is in charge. An Allis-Chalmers dis-
ice, with temporary headquarters in
cott Square Bldg., has been opened in
under the management of George W.
Mr. Pulver is well known through-
district of which Buffalo is the cen-
ing been for a number of years with
stinghouse Electric & Mfg. Co., at
racuse office, and acting manager of
ce until recently.

nited States Government has adopted
talled Universal pipe, made by the
Foundry Co., 116 Nassau St., New
ı Ellis Island, New York Harbor, and
o specified it for other places. The
s also been laid under a number of
ncluding the Black River at Lorain, O.
County Commissioners of Dekalb
Indiana, awarded contracts for nine
steel arches as follows: Four to R.
man & Co., Lafayette, Ind.; three to
t Wayne Arch & Culvert Co., and two
ımer & Johnson, Hicksville, O., upon
urnished by the Ft. Wayne Arch &
Co., using Lane's patent steel-cen-
oncrete arch construction.

annual convention of officers and
managers of Crocker-Wheeler Co. took
t the main office and works, Ampere,
Jan. 26-28. Managers and represent-
were in attendance from all parts of
ntry, and were unanimous in predict-
prosperous season during the coming
the field of alternating current gen-
and direct-current generators and
On the evening of the 27th a ban-
as held at the Café Martin in New
t which the president of the company,
ıuyler Skaats Wheeler, presided.

uss rod for reinforced concrete beams
en patented in the United States by
ont Jarvis, McKinnon Bldg., Toronto,
now placing district rights for its use.
uss consists of a series of flat bars
are bound together by clamps, but have
nds turned up in an inclined direction,
ıat after the arrangement of the bent-
tions of a Kahn bar.

New York Continental Jewell Filtra-
. reports the following recent sales of
Henry G. Long Asylum, Lancaster,
rs. J. F. Smith, Philadelphia; Richard
Curdy, Morristown, N. J.; Henry H.
, Jr., Philadelphia; Bell Building, New
Robert H. Thompson, New York; C. W.
Wheeling, W. Va.; Dr. C. W. Hallo-
Philadelphia; additions to Bangor, Me.,
Works, The Jefferson Laundry, Rich-
Va.; New England Cotton Yarn Co.,
n, Mass.; The Angola Dyeing Co.,
elphia; The Glover Mfg. Co., Juliette,
as. Kennedy, Troy, N. Y.

Dimmick Pipe Co., Birmingham, Ala.,
contracts for building and machinery
ıew shop. The building will be of steel
ıction and fireproof throughout. In its
t shop, the company manufactures sizes
g from 3 in. to 36 in., inclusive, and
capacity of 175 tons of pipe per day.
p No. 2 will be manufactured sizes
6 in. to 84 in., inclusive, and the com-
tonnage of the two shops will be over
ns per day. By moving some of the
sizes from the present shop to shop
the company will be able to increase its
ty on the smaller sizes. The company
to manufacture pipe in this shop by
l, and will be prepared to undertake
ntracts for all sizes. In addition to
here are under contemplation extensive
ements in the other departments of the
The capital stock of the company will
reased in order to take care of these
ements.

Westinghouse companies have entered
ler for the equipment of a power-house
e electrical operation of gold-dredging
on the Alaskan rivers. A number of
t capitalists recently formed the Can-
Klondike Mining Co. for this purpose,
re to install a 400-kw. turbo-generator
power-house, to be driven by a 600-
Westinghouse-Parsons steam turbine.
ıredge boats are being built by the Ma-
Steam Shovel Co., of Marion, O., and
arry 500 h.p. in induction motors vary-
size from 7½ to 100 h.p. The power-
will be located at Dawson City, and
redges will operate on the Yukon River
ts tributaries. The Westinghouse Elec-
Mfg. Co. has also closed a contract
the United Railways & Electric Co., Bal-
e, for a 5,000-kw. alternating-current
ator of the fly-wheel type, to run at
94 r.p.m., and wound for 13,000 volts, three-phase, with a frequency of 25 cycles. It is to run in parallel with the five 2,000-kw. Westinghouse generators in the Pratt Street station. The company has also sold to the La Belle Iron Works, Steubenville, O., a 1,000-kw., 250-volt, direct-current engine-type generator, to add to the Westinghouse apparatus already installed in this plant, with a total rated capacity of 1,250-kw. in generators, a 300-kw. rotary converter, and over 200 motors.

PERSONAL NOTES.

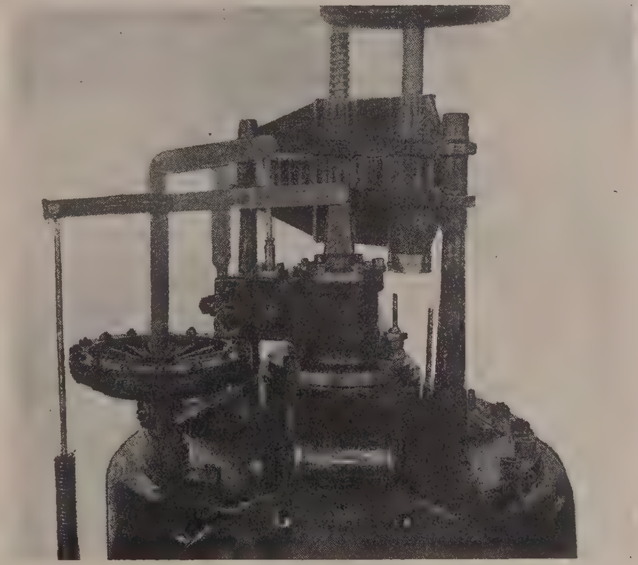
Mr. John S. Elliott, Asso. M. Am. Soc. C. E., the newly appointed Commissioner of Interior of Porto Rico, sailed from New York, Feb. 4, for Porto Rico.

Mr. Samuel Whinery, M. Am. Soc. C. E., has been appointed consulting engineer in the department of street paving, borough of Manhattan, New York City.

Major John S. Hendrie, vice-president of the Hamilton Bridge Works, has become one of the ministers in the administration of the premier of Ontario, Hon. James P. Whitney.

Mr. H. DeB. Parsons, of New York, has been retained by District Attorney Jerome to make an investigation of the condition of several New York theaters believed to be unsafe.

Mr. W. D. Lovell, M. Am. Soc. C. E., who has offices in Minneapolis, Minn., and Des Moines, Iowa, sailed on the Oceanic, Feb. 15, to spend several months in investigating foreign water supply systems.



THE STURGESS HYDRAULIC RELIEF VALVE.

The headquarters of the Third Mississippi River District has been moved from Memphis, Tenn., to Vicksburg, Miss., and transferred from Capt. E. Van C. Lucas to Capt. G. M. Hoffman, Corps of Engineers, U. S. A.

The A. D. Granger Co., contracting engineers for power-house equipment and complete power plants of New York and Philadelphia, has opened an office in the Bessemer Bldg., Pittsburg, under the management of Mr. E. W. Bentley.

Bridge draftsmen are required by the State of New York, and candidates for the positions will be examined on March 11. The pay ranges from $900 to $1,500 a year. Particulars can be obtained from the State Civil Service Commission, Albany.

Messrs. Copeland & Dole, architects, have moved their office to the Royal Bldg., Fulton and William Streets, New York City, and desire to receive catalogues and samples from the trade to replace those destroyed by the fire which recently burned out their office.

Mr. H. J. Stanley, for 25 years city engineer of Cincinnati, O., died Feb. 9, after an illness of several months. Mr. Stanley rose from the position of draftsman through various positions until he became chief of the department in 1880, and held the position continuously until the time of his death.

Carl Otto Iben, an engineer connected with the Hamburg municipal works, and for many years a careful student of American waterworks practice, died on Jan. 21. He probably did more than any other German to make American plants familiar to German engineers, for he was a prolific contributor to the technical press of his country.

Mr. H. G. Stott, superintendent of motive power of the Interborough Rapid Transit Co., of New York, addressed the Brooklyn Engineers' Club, Feb. 16, on "The Management of a Great Power Plant," and arranged for a visit by the club to the subway power-house at 59th St. and the North River, scheduled for the afternoon of Feb. 18.

Mr. W. L. Biersach has sailed for Europe, for the works of J. M. Voith, Heidenheim-a-d-Brenz, as representative of Messrs. P. N. & L. L. Nunn, engineers for the plant of the Ontario Power Co., of Niagara Falls. He is to secure the shipment of the third 11,000-h.-p. hydraulic turbine, to negotiate for the fourth turbine, and to arrange for ordering by cable the fifth, sixth and seventh turbines.

Mr. George Hornung, consulting hydraulic and mechanical engineer of Cincinnati, O., has been employed by the city of Covington, Ky., to investigate and report upon the most feasible plan for the laying of a new 30-in. supply pipe across the Licking River, and also to examine the condition of the pumping plant and report whether any improvements could be made whereby the cost of pumping and delivering the water could be reduced.

Mr. H. S. Reynolds, who has for the last four years managed the Stone & Webster interests in Columbus, Ga., which consist of all the street railway, electric light and gas properties in that city, has resigned to accept a position in the operating department of J. G. White & Co., engineers and contractors, 43 Exchange Place, New York, and will reside in New York in the future. Mr. Reynolds is a graduate of the Massachusetts Institute of Technology, class of 1894, and since graduation has devoted his entire time to the construction and operation of street railway, electric light and gas plants, among them being that of the Brockton, Mass., St. Ry. Co.

The Carnegie Institution of Washington has recently made a grant of $2,500 to Professor C. F. Burgess, of the Department of Applied Electro-Chemistry of the College of Engineering, University of Wisconsin, to aid him in carrying out investigations upon the properties of pure iron and its alloys. During the past three years Prof. Burgess has developed a method of producing iron electrolytically of a very high degree of purity, in a manner similar to that employed in the refining of copper. Previous to this work pure iron had been obtained only in very small quantities and at excessive cost, but Prof. Burgess is now able to produce comparatively large quantities at a small cost, using for this purpose a cheap grade of steel. Careful analysis of this product fails to show the presence of any foreign element, with the exception of hydrogen, which can readily be driven off by heat. There is already a considerable demand for this iron for scientific purposes, and about half a ton has already been made. The possibility of producing pure iron on a comparatively large scale opens up a very promising line of investigation with reference to the qualities of the pure iron itself, and of any desired alloy with other elements.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

**Montgomery, Ala.*—The Allis-Chalmers Co., Milwaukee, Wis., is stated to have secured the contract for the installation here of an 8,000,000-gal. flywheel pumping engine.

Sylacauga, Ala.—See "Power Plants, Gas and Electricity."

Santa Ana, Cal.—It is stated that bids are wanted Feb. 27 for furnishing c. i. water pipe, hydrants, gates, etc. Edw. Tedford, City Clk.

Bishop, Cal.—Engineers Lippincott & Parker, 117 Braly Bldg., Los Angeles, write that the date of opening of bids for the construction of water works, bids for which were to have been opened on Feb. 10, by the Town Trus. (as advertised in the issues of The Engineering Record of Dec. 10, 17 and 24) has been postponed until Mar. 10.

Meeker, Colo.—Bids will be received by the Bd. of Trus., on Mar. 4, for furnishing material and constructing a system of water works, as advertised in The Engineering Record.

Montrose, Colo.—Frank L. Ross, Deputy City Clk., writes that final details are being completed for the construction of water works, which will cost $100,000.

Valdosta, Ga.—It is reported that probably $8,000 will be expended by the city in improvements to the water works station.

Waterman, Ill.—It is reported that bids will be received Feb. 28 by S. M. Henderson for furnishing material and constructing water works, including pumping station, 15-h.-p. gasoline engine, air compressor, tank, etc.

Mendon, Ill.—The water works plant is reported to have been destroyed by fire. It is proposed to construct a pumping station about 3 miles south of Myer. W. P. Bushnell, of Quincy, is engineer; B. A. Van Dyke, Mayor.

Chicago, Ill.—Bids are wanted Feb. 21, for furnishing and installing at the 68th St. Pumping Station a horizontal compound condensing pumping engine having capacity of 20,000,000 gal. per 24 hours. F. W. Blocki, Comr. Pub. Wks.

Kirkland, Ill.—The Council is reported to have under consideration the construction of water works, at a cost of $6,000.

Jacksonville, Ill.—Julius and Daniel Seligman are reported to have secured a franchise to pipe water from Gravel Spring to this city for bottling; length of proposed line is 6 miles.

Ridgefarm, Ill.—The question of establishing water works is reported under consideration.

Virden, Ill.—There is reported to be a movement on foot here to establish water works.

East Moline, Ill.—The Village Trus. are reported to have under consideration the construction of water works and a sewerage system.

**South Bend, Ind.*—The U. S. Cast-Iron Pipe & Fdy. Co., Chicago, Ill., has secured the contract for furnishing from 750 to 1,200 tons of c.-i. pipe at $25.20 per ton, and specials, $52 per ton.

Iowa Falls, Ia.—Bids will be received by the City Council on March 6 for furnishing all tools, labor and material necessary to construct a pumping plant, as advertised in The Engineering Record. Specifications on file at this office.

Sioux City, Ia.—It is proposed to expend $60,000 for a new pumping station and water main extensions.

Hoisington, Kan.—This city has for sale $25,000 water works bonds; correspondence invited. Plans and specifications have been prepared by Burns & McDonnell, Dwight Bldg., Kansas City, Mo.

**Lindsborg, Kan.*—N. J. Thorstenberg, Mayor, writes that the contract for furnishing and delivering about 200 tons of 4, 6, and 8-in. c.-i. pipe, and 3 tons of specials (bids opened Jan. 20) has been awarded to the U. S. Pipe & Fdy. Co., of Chicago, Ill.

Dawson Spring, Ky.—A. E. Orton, City Clk., writes, that it is not proposed at the present time to construct water works.

Williamsburg, Ky.—Jos. L. Sutton has secured a franchise for the construction of water works; probable cost of system will be $25,000.

Bowling Green, Ky.—City Engr. Wilkerson is stated to have been instructed by the Bd. of Pub. Wks. to prepare plans for a new engine for the water works station, to cost about $25,000.

Cloverport, Ky.—See "Power Plants, Gas and Electricity."

Covington, Ky.—The Water Works Comrs. contemplate making a new connection between Covington and Newport. It will be paid for partly by each city. The cost will probably be about $20,000, but the work has not been decided upon yet.

Hammond, La.—The citizens are reported to have voted Feb. 7 to issue $30,000 for water works and drainage.

**Items marked thus give the names of parties awarded contracts.*

Abbeville, La.—See "Power Plants, Gas and Electricity."

New Orleans, La.—Bids will be received by the Sewerage & Water Bd. on April 18 (readvertisement) for furnishing the following water works machinery, as advertised in The Engineering Record: Four 20,000,000-gal. pumping engines; 3 40,000,000-gal. centrifugal pumps; 3 engines to operate these centrifugal pumps; 1 20,000,000-gal. centrifugal pump; 1 engine to operate 20,000,000-gal. centrifugal pump; 2 150-kw., 550-volt, direct-current generators; 2 engines to drive these generators; 6 400-h.p. water-tube boilers, and also all steam and water pipe connections and other appurtenances complete for operation within, and connecting the boiler and pump house buildings.

New Orleans, La.—See "Sewerage and Sewage Disposal."

New Orleans, La.—Bids will be received by the Sewerage and Water Bd. on Apr. 25 (readvertisement) for the construction of 16,000 lin. ft. of wood-lined canals, and laying 15 miles of water pipe, as advertised in The Engineering Record.

Williamstown, Mass.—C. L. Sanford, Supt. Water Wks., writes that it is proposed to expend about $30,000 in improvements to include 2 miles of pipe, 8 and 12-in. diameter.

Beverly, Mass.—The House has voted to admit the petition of Mayor Wallace, that Beverly incur an indebtedness of $100,000 for water supply purposes and $250,000 for school purposes.

Boston, Mass.—Bids will be received Feb. 21, by Eugene S. Sullivan, Water Comr., Rm. 58 City Hall, for furnishing 2,000 tons c. i. water pipes.

Grand Rapids, Mich.—According to local press reports, the cost of an up-river water supply, is estimated at $544,000. L. W. Anderson, City Engr.

**Glenwood, Mich.*—The following are reported to be the bids opened Feb. 6 for the construction of water works: Brooks & Son, Jackson, $14,163 (awarded contract); Frank C. Brown, Romeo, $15,546, and H. D. Thayer, Bellevue, O., $15,099.

Clare, Mich.—G. E. Benner, City Clk., writes that it was voted Feb. 6 to issue $14,750 bonds for the construction of water works.

Springfield, Minn.—There is reported to be some talk of constructing water works here.

Mendon, Mich.—Press reports state that estimates are being procured for municipal water works.

Detroit, Mich.—Bids will be received Feb. 21 by the Bd. Water Comrs. for $150,000 water bonds. Benj. F. Quiney, Secy.

Vicksburg, Miss.—Harry K. Johnson, of Natchez, Miss., and Beaumont, Tex., is reported to have petitioned Council for a franchise for water works and a sewerage system.

Medina, N. Y.—Bids will be received until Mar. 1 for furnishing material and constructing water works, as advertised in The Engineering Record.

New York, N. Y.—The Bd. of Estimate on Feb. 10 authorized the granting of an appropriation of $2,000,000 to the Aqueduct Comn. to carry on reservoir work.

John T. Oakley, Comr. Water Supply, Gas and Electricity, announced, Feb. 10, the completion of the plans for a high-pressure water main system from the Battery to 42d St., for which the Bd. of Estimate has appropriated $3,900,000. The plans were drawn by Deputy Ch. Engr. De Varona and divide the territory south of 42d St. into three districts, with a pumping station for each district; one will be erected at the Battery, another at the foot of Grand St., on the east side, and a third at the foot of Christopher St. on the west side.

Rochester, N. Y.—The only bid received and opened on Feb. 8 y the Bd. of Contract for furnishing stop gates and special castings for use at the proposed reservoir at Cobbs Hill, is stated to have been submitted by the Rensselaer Mfg. Co., of Troy, for $13,600.

Local press reports state Fred. P. Stearns, of Boston, Mass., has visited the site of the proposed Cobbs Hill reservoir, and revised the plans made by local engineers. It is proposed to construct a reservoir with a capacity of 100,000,000-gal. It will have an average depth of 25 ft., a length of 1,500 ft., and a breadth of 670 ft.; cost of reservoir, including land, will be about $600,000.

*R. D. Wood & Co., of Philadelphia, Pa., are stated to have secured the contract for furnishing pipe for the Water Wks. Dept. for the year 1905. Its bid is reported to have been $109,200 for 4,300 tons of pipe. About $40,000 worth of pipe will be ordered at once to be laid in city streets. More pipe will be ordered as required by the city.

Spencerport, N. Y.—The Ontario Water Co. is reported to have presented a proposition to the Village Trus. for the installation of water works.

Ft. Caswell, N. C.—Specifications for the material and labor required for sinking a 6-in. tubular deep well at Ft. Caswell are on file in the office of The Engineering Record, 114 Liberty St., Room 607. Bids will be received for this work on March 21, as advertised in The Engineering Record.

Miamisburg, O.—See "Power Plants, Gas and Electricity."

Youngstown, O.—Separate bids will be received until Mar. 3 by the Bd. Pub. Service for the following: 125 or less ⅝-in., 40 ¾-in., 15 1-in., 2 1½-in., 12 2-in., 2 3-in. and 1 4-in. water meters; 75 6-in., 20 8-in., 2 10-in., 2 12-in., 2 20-in., 1 30-in., and 12 4-in. water valves; 900 tons 4 to 30-in. c. i. pipe, and 30 tons or less of special castings; 75 or less fire hydrants, and 150 or less screw valve boxes. G. T. Prosser, Clk.

Ashtabula, O.—The Ashtabula Water Co. is reported to be considering the construction of a filtration plant.

Lorain, O.—Bids will be received by the Bd. of Pub. Service, Mar. 11, for constructing a settling basin at the water works pumping station 150 ft. long, 50 ft. wide and 24 ft. deep, to be of concrete or brick, probable cost, $10,000. Chas. S. Ferguson, City Engr.

Cincinnati, O.—Bids will be received by the Bd. of Trus. Comrs. of Water Works on Mar. 17, for furnishing and delivering c. i. pipe and special castings for the coagulating basins, etc., at California, as advertised in The Engineering Record.

Prairie City, Ore.—See "Power Plants, Gas and Electricity."

Ford City, Pa.—Bids will be received by the Borough Council on March 6 for designing, furnishing and erecting pumps and gas engines, as advertised in The Engineering Record.

Clinton, S. C.—See "Power Plants, Gas and Electricity."

Belle Fourche, S. D.—Bids will be received at the office of the U. S. Reclamation Service, Chamber of Commerce Bldg., Denver, Colo., on April 10 for the construction of dam and regulator, and 6½ miles of canal with auxiliary works, for diverting the flow of water of Belle Fourche River, and conducting same to reservoir, 6 miles northeast of Belle Fourche, as advertised in The Engineering Record.

Knoxville, Tenn.—The House is reported to have passed a bill authorizing the city to issue $200,000 water works bonds.

Salt Lake City, Utah.—Bids will be received Feb. 27, by J. S. Critchlow, City Recorder, for $850,000 bonds to be used to increase and improve water supply and $150,000 bonds to establish a sewer system in Southern and Western portion of said city.

Crandon, Wis.—G. A. Lancaster, Deputy City Clk., writes that the citizens voted Feb. 4 to issue $30,000 bonds for the construction of water works. Engineer, Geo. C. Morgan, 169 Jackson Boule., Chicago, Ill.

Milwaukee, Wis.—Bids will be received Feb. 24 by the Bd. Pub. Wks. for furnishing 1,600 tons 4, 6, 12 and 16-in. c. i. water pipe for water mains of said city. Bidders will state price per ton for said pipe delivered f. o. b. cars in Milwaukee. Chas. J. Poetsch, Chmn.

Ft. D. A. Russell, Wyo.—Bids are wanted March 7 for extension of water system at this post, consisting of about 370 ft. 6-in. and 340 ft. 4-in. c. i. pipe, 2 fire hydrants, etc. Capt. W. S. Scott, Constructing Q. M., U. S. A., Cheyenne.

Winnipeg, Man.—Bids will be received by the chairman of the Fire, Water & Light Com. on April 10 for 1,750 tons of water pipe and specials of various sizes, as advertised in The Engineering Record.

Toronto, Ont.—The City Engr. is reported to have asked for $225,000 for a new pumping station and $144,145 for new water mains.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Bishop, Cal.—Engineers Lippincott & Parker, Braly Bldg., Los Angeles, write that the date of opening of bids for the construction of a sewerage system, bids for which were to have been opened by the Town Trus. on Feb. 10 (as advertised in The Engineering Record of Dec. 10, 17 and 24), has been extended to Mar. 10.

Ocean Park, Cal.—P. James, City Clk., writes that it was voted Jan. 30 to issue $20,000 bonds for the construction of a sewerage system.

Denver, Colo.—The Bd. of Pub. Wks., is stated to have adopted specifications for the construction of a sanitary sewer in Highlands to be known as Sanitary Sewer Dist. No. 8; probable cost of construction, $30,459.

Atlanta, Ga.—Bids will be received Mar. 6 by the Mayor and General Council for furnishing, setting curb and laying brick sidewalks, constructing lateral sewers, furnishing cement, vitrified pipe and castings for sewer work. R. M. Clayton, City Engr.

Macon, Ga.—It is proposed to construct a sewerage system for Vineville and Huguenin Heights, at a cost of $40,000. W. A. McKenna, Chmn, Sewer Com.

East Moline, Ill.—See "Water."

Topeka, Kan.—The following are the totals of bids opened on Feb. 6 for the construction of brick and pipe sewers: Hanley & Ritchie, Iola, $79,892; M. Cook & Son, Junction City, $80,225, and Brooks & Gilmore, Topeka, $84,588.

**Kansas City, Kan.*—The City Council of Kansas City is stated to have on Feb. 7 awarded to John Mahoney, 510 Ohio St., the contract for constructing a sewer on the Muncie Boule., in Armourdale, for $41,000.

Covington, Ky.—The city will during the coming season build part of the Willow Run Sewer, at a cost of about $12,000. It will be of concrete, probably reinforced. The sewer will be partly 6½ ft. diam., and partly 7½ ft. diam. This will be in two contracts.

Hammond, La.—See "Water."

New Orleans, La.—Bids will be received by the Sewerage & Water Bd. on April 18 (readvertisement) for the construction of 65 miles of sewers and appurtenances, and the furnishing of 15 miles of cast iron water mains and appurtenances, as advertised in The Engineering Record.

Houston, Tex.—The following are the bids opened on Feb. 6 for constructing pipe on Louisiana St., (F. L. Dormant, City Engr.); (*a*) Collins Bros., Houston, Tex., (S. Hipp, Houston, (*c*) Suderman, Dolson & Co., Houston; (*d*) C. S. Tucker, Houston J. C. Kelso, Galveston; (*f*) F. J. Sargeant, Brownsville, Tex.; (*g*) E. G. Trueheart, San tonio:

Pipe sewer:	*a.*	*b.*	*c.*	*d.*	*e.*	*f.*
65 lin. ft. 8-in., 0 to 6 ft.	$0.45	$0.50	$1.16	$0.92	$0.40	$0.65
8-in., 6 " 8 "	.50	.50	1.26	1.09	.50	.72
15-in., 0 " 6 "	.95	1.50	1.50	1.50	.80	.92
15-in., 6 " 8 "	1.05	1.50	1.70	1.80	.80	1.07
1,450 lin. ft. 24-in., 0 " 6 "	2.13	3.39	2.36	2.70	2.00	2.55
1,700 " 24-in., 6 " 8 "	2.35	3.39	2.46	3.13	2.00	2.75
2,800 " 24-in., 8 " 10 "	2.57	3.39	2.63	3.76	2.36	3.21
150 " 24-in., 10 " 12 "	2.80	3.39	2.85	4.11	2.55	4.11
22 manholes up to 8 ft. deep	60.00	49.40	65.00	65.45	75.00	42.50
Each additional foot	4.00	7.00	5.50	7.50	5.00	1.00
5 cu. yd. concrete	8.00	8.00	6.50	7.75	6.25	6.00
Lumber, as needed, per M. ft.	25.00	30.00	30.00	27.00	30.00	20.00
20 cu. yd. excav. (extra)	.50	1.40	1.00	1.25	.40	.67
4 flush tanks	80.00	90.00	100.00	96.80	90.00	72.00
Catch basins, as needed, each	60.00	47.50	55.00	51.70	50.00	47.00
Totals	$16,520	$22,368	$17,474	$22,476	$15,476	$19,340

Note.—The 8 and 15-in. pipe is to be supplied as needed.

Abbeville, La.—See "Power Plants, Gas and Electricity."

Baltimore, Md.—The second branch ordinance appropriating $144,500 for the paving of certain streets, and $93,000 for sewers, as provided by the Bd. of Estimates, was passed by first branch of City Council on Feb. 8.

Northampton, Mass.—Egbert I. Clapp, City Clk., writes that the extension of the outlet of the sewerage system, about 300 ft., and the clearing out of the bed of Mill River for several hundred feet below the point of location of sewer outlet, is in contemplation. It will be of brick and several feet in diameter, cost about $15,000, and will probably be constructed under supervision of Malcolm D. Patteson, City Engr.

Worcester, Mass.—The State Bd. of Health is stated to have approved plans for the sewage disposal of the Worcester Insane Hospital.

Monroe, Mich.—The City Council is reported to have authorized the Bd. of Pub. Wks., to report on the probable cost of a trunk line sewer on the south side, from the westerly limits of city to Cole dock; it will be about 2 miles in length.

Pipestone, Minn.—Loweth & Wolff, of St. Paul, are reported to have completed plans for the proposed sewerage system; estimated cost of sewers including septic tank, is about $13,500.

Duluth, Minn.—City Engr., McGilvray is stated to have completed plans for two sewer systems—a system on Duluth Heights will cost $68,369; while the sewer for the district lying east of Lester River, will cost $3,017.

Vicksburg, Miss.—See "Water."

Cape Girardeau, Mo.—It is proposed to construct a sewerage system here at a cost of $35,000. Engineer, Granberry Jackson, of Nashville, Tenn.

Deal Beach, N.J.—The Council is reported to have decided to expend about $160,000 in improvements. It is proposed to purchase the sewer system, take over control of streets, and also purchase land on Deal Esplanade, bordering on ocean and erect on same a pavilion, bath houses, swimming pool, etc.

Brooklyn, N. Y.—Bids will be received until Mar. 1 by Martin W. Littleton, Pres. Brooklyn Boro., for furnishing material and constructing a sewer in 76th St. between 4th and 6th Aves., requiring about 815 lin. ft. 18-in., 45 lin. ft. 15-in., and 810 lin. ft. 12-in. pipe sewer, 16 manholes, and 3 sewer basins, and for constructing a sewer basin at Barbey St. and Arlington Ave., Palmetto St. and Evergreen Ave., and Oakland and Ash Sts., and for furnishing, delivering, housing and trimming 6,750 bbls. quick-lime at the several sewage disposal works in the 26th, 31st and 32d Wards.

Elmira, N. Y.—An appropriation of $10,000 has been made for new sewers and repairs during 1905. F. Leach, City Engr.

Hempstead, L. I., N. Y.—The Nassau County Sewerage Co. is reported incorporated, with a capital of $10,000, to install a sewerage system in Hempstead and in other places in Nassau County. Directors: H. P. Keith, Robertson Honeyman and Lawrence Kerwin.

Chillicothe, O.—H. M. Reid, City Engr., writes that bids will be received on Feb. 20 by the Bd. of Pub. Service for the construction of pipe sewers, to cost $11,000.

Columbus, O.—The Council on Feb. 13 passed an ordinance providing for an issue of $125,000 bonds to complete the central relief sewer. It also passed on second reading the ordinance for an issue of $135,000 bonds for the 2d Ave. relief sewer.

Lorain, O.—Bids will be received by the Bd. of Pub. Service on Mar. 11, for the construction of brick sewers as follows: 1,920 lin. ft. 5-ft.; 580 lin. ft. 5½-ft.; 800 lin. ft. 6 ft.; also 2 overflow chambers, one for No. 3 brick sewer, the other for No. 2 brick sewer, 10 manholes, 1 outlet, 1 grating and inlet; cost $45,000. Chas. S. Ferguson, City Engr.

Middletown, O.—Local press reports state that the Clk of the Bd. Pub. Service has been authorized to receive bids until Feb. 21 for constructing the Yankee Road sewer and for the Woodland Ave. improvement.

Blackwell, Okla. Ter.—Burns & McDonnell, Dwight Bldg., Kansas City, Mo., have been selected to prepare plans for a sewerage system for Blackwell.

Norristown, Pa.—It is stated that bids are wanted Mar. 1 for constructing 8-in. vitrified sanitary pipe sewer in Penn St. Wm. J. Wells, Chmn. Sewer Com., 1221 Arch St.

South Sharon, Pa.—Sewer bonds to amount of $100,000 are reported sold.

**Wilkinsburg, Pa.*—Frease & Spe Boro. Engrs., write that the contract fo structing sewers in Anderson and Cresso (bids opened Feb. 9) has been award- Bodine & Co., 1218 Westinghouse Bldg., burg, for $3,500.

Providence, R. I.—Plans are being pre by the City Engr. for the drainage of 1,200 acres of land in the Pleasant section bet. Chalkstone Ave. and Smith in the 10th Ward.

Laredo, Tex.—It is reported that Quartermaster's Dept. will expend $100,000 for new buildings and sewera the post here.

Salt Lake City, Utah.—See "Water."

Tacoma, Wash.—Jos. Blass and Chas. of the South Tacoma Improvement Club stated to have petitioned Council to struct the Edison trunk sewer; the City gineer estimates the cost of this sew $64,000.

North Yakima, Wash.—The citizens on Feb. 7 to issue $57,000 bonds to cons about 5 miles of mains for the sewer drainage system, from plans of Ernest Colloh, of North Yakima, who will charge of construction work. In additi this, it is expected that during the sum number of laterals will be constructed paid for under local assessment plan. Brooker, City Clk.

**Milwaukee, Wis.*—The following ar bids opened by the Bd. of Pub. Wks. on 10 for constructing a brick and concre take conduit 132 ft. long for Milwaukee flushing tunnel in the 18th Ward: Hickey, $5,435 (awarded contract); Crilley, $5,973; J. E. Hathaway, $9,84 J. E. Meyers, $7,464.

Brandon, Man.—Bids will be received 1 by J. B. Whitehead, Secy.-Treas., for lin. ft. 8-in. vitrified sewer pipe and bbl. Portland cement, as advertised i Engineering Record.

Hamilton, Ont.—The Sewer Commit stated to have completed its estimat will require $11,356 for the Ferguson disposal works, $7,240 for the Wentwo works, and $8,049 for general work.

BRIDGES.

Notes Arranged Alphabetically by St

Tombstone, Ariz.—It is stated tha will be received Mar. 1 by the Bd. S for constructing 2 steel bridges ove Pedro River. J. J. Bowen, Chmn.

Chicago, Ill.—Plans are stated to been completed by Comr. Blocki for th cule bridge to be constructed at Nort According to reports, bids will soon ceived.

Auburn, Ind.—See "Business Notes."

Valparaiso, Ind.—It is reported th will be received Mar. 6 by the Bd. Co. for constructing a 46-ft. steel bridge crete and piling foundation. S. P. Co. Aud.

**Indianapolis, Ind.*—Local press state that the lowest bids received County Comrs. on Feb. 7 for constru bridge over White River at River A as follows: On plans *a* and *b* supers the King Bridge Co., of Cleveland, C 000; plan *c* superstructure, the Ne Bridge Co., of Indianapolis, $58,350 ed contract); for substructure, Moor field Constr. Co., Stevenson Bldg., $63,687 (awarded contract;. and H. C & Co., plan *b*, $84,939.

Crawfordsville, Ind.—It is stated t County Comrs. have decided to const iron bridge with stone abutments ov Creek, near Waynetown.

**Wabash, Ind.*—W. L. Davis, C writes that John A. Ross, of Frankf secured the contract for constructing ft. viaduct across Charly Creek (bids Feb. 7), for $7,100.

Harvey, Ia.—It is stated that th Island R. R. Co. (W. L. Darling, Ch Chicago, Ill.) will construct a stee over Des Moines River at Harvey, $40,000.

**Des Moines, Ia.*—The contract fo approaches to S. E. 6th St. bridg opened Jan. 31) has been awarded & Sweeney, 217 E. 9th St., for $3,500

Sioux City, Ia.—It is proposed to a viaduct 800 ft. long with two sp 130 ft., the other 40 ft., with concr ments. J. M. Lewis, City Engr.

Items marked thus give the names of parties awarded contracts.

apids, Ia.—The City Council at its eb. 10, passed a resolution to oncrete bridge across Cedar River e., to cost about $75,000. C. D. ayor; T. H. McCauley, City Engr.

a, Kan.—Bids received for con- approach to the Kaw River Bridge d to have been as follows: Topeka Iron Mfg. Co., $22,784; Crebo Con- $23,300; Missouri Bridge Co., $23,- . Dildine, $23,900, and the Marsh o., of Des Moines, Ia., $24,200 contract).

rdia, Kan.—The following bids are have been received for constructing iere: Watson & Co., $7,350; Leaven- idge Co., $7,324; Midland Bridge 6; P. S. Easterday, $7,465; Canton o., of Canton, O., $7,185 (awarded ; A. N. Blodgett Co., $7,450; J. W. ., $7,318; E. L. Dildine, $7,597, and ican Bridge Co., $7,700.

, Ky.—The Brockett Bridge Co., of l, O., is stated to have received the for constructing a bridge over Beech r about $7,500.

ld, Mass.—See "Electric Railways."

, Mich.—It is stated that the Grand y. Co. (J. Hobson, Ch. Engr., Mon- e.) will construct a bridge over the River.

Rapids, Mich.—City Engr. L. W. An- stated to have submitted to the Bd. Wks. estimates for the Ann St. By using 1 span of the Pearl St. and 6 of the Bridge St. Bridge the expense will be $66,602, if erect- e line of Ann and Victoria Sts., or if erected on the line of Sweet and ts. By using 3 new 200-ft. trusses, nse would be $89,754 if the bridge cted on the line of Ann and Victoria $87,638 if erected on the line of nd North Sts.

aul, Minn.—See "Paving and Road- "

Neb.—Bids will be received Apr. 4 3d. Co. Superv. for constructing steel F. W. Stevens, Co. Clk.

h Platte, Neb.—Fred. R. Ginn, Co. ites that the Canton Bridge Co., of has secured the contract for con- g a single-track wagon bridge, 3,200 across North Platte River (bids Feb. 6.

a, N. Y.—A special commission has pointed by act of Legislature with y to repair old bridge at Lake St., or t a new one, at a cost not to exceed F. Leach, City Engr.

York, N. Y.—The Bd. of Estimate on granted the request of Geo. E. Best, of Bridges, for an appropriation of 0 to improve the elevated tracks at hattan end of Brooklyn Bridge. The all for additional tracks and addi- pace on platforms, and will allow bet- n-loading facilities.

lyn, N. Y.—The Bd. of Estimate on , adopted the report of the commit- ntly appointed to consider the propo- for approaches to the Williamsburg in Brooklyn Boro. The committee the adoption of all plans proposed provides for the extension of Grand Bedford and Montrose Aves., and the g of Roebling St.

smouth, O.—The Portsmouth St. Ry. nt Co. has in contemplation the con- on of a viaduct over its tracks at 10th . D. York, Pres., Portsmouth.

benville, O.—The construction of a over Ohio River at a cost of $80,000 rted under consideration.

sgrove, Pa.—Bids will be received un- . 28 by J. M. Shumaker, Supt. of Pub. ls and Bldgs., at Harrisburg, for re- g the superstructure of the highway across Penn's Creek, 1 mile north of rough of Selinsgrove.

nton, Pa.—Plans are stated to have dopted by the Scranton Ry. Co. (Frank n, Gen. Mgr., Scranton) for the con- on of a viaduct over the tracks of On- Western R. R. and Lackawanna River lberry St.

idence, R. I.—Bids will be received by . of Comrs. at the office of O. Perry C. E., 146 Westminster St., on Mar. r constructing a draw span for the Island Stone Bridge; also on same or building the approaches for this both advertised in The Engineering .

s are being prepared in the City Engi- office, for a possible new bridge over ence River at Point St. The old bridge t. wide, one 250-ft. draw and two 140-ft. spans.

xville, Tenn.—Plans are stated to have repared for the 700-ft. concrete viaduct onstructed on Clinch Ave., by the city, uisville & Nashville Ry., the Southern d the Knoxville Traction Co.

boygan, Wis.—See "Railroads."

aukee, Wis.—The City Council has ized Chas. J. Poetsch, City Engr., to e specifications for the construction of uct to 6th St., probable cost $550,000.

nipeg, Man.—The construction of 2 bridges over Red River is reported un- nsideration; estimated cost, $100,000.

nedosta, Man.—It is stated that bids e received by E. B. Fisher, Village Clk., building and extending Main St. iron

Juan, Porto Rico.—See "Paving and aking."

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Hot Springs, Ark.—The construction of a turnpike extending from Hot Springs through Ozark Lithia Springs to Mountain Valley Springs, a distance of about 12 miles, is reported under consideration. According to reports, F. W. Eveland is interested.

Augusta, Ga.—According to reports, the contract will soon be let for paving a portion of Jackson St.; probable cost, $15,000.

Atlanta, Ga.—See "Sewerage and Sewage Disposal."

Chicago, Ill.—The Bd. of Local Improv. is stated to have on Feb. 8 decided to pave portions of the following streets: Ogden, Emerald, Lake, La Salle and N. Hoyne Ave., Ann and N. Paulina Sts., Ayers and Gault Court.

Springfield, Ill.—The City Council is stated to have decided to pave the cemetery road; estimated cost, $25,000.

**Marion, Ind.*—L. C. Lillard, of Marion, is stated to have received the contract for constructing the cemetery boulevard, for $17,-251.

Indianapolis, Ind.—Bids will be received until Mar. 1 by the Bd. Pub. Wks. for repairing asphalt and vulcanite street pavements on which the guarantee period of maintenance has expired. Bidders are to state price per sq. yd. on each class of repairs as follows: Skin coat, which shall include patches not less than 1 in. and not greater than 1½ in. thick and not to concrete foundation; resurfacing, which shall include material to the concrete foundation; new concrete and new surface. M. A. Downing, Chmn.

Bedford, Ind.—Bids will be received until Mar. 9 by the Co. Comrs. (Anselm Wood, Chmn.), for constructing the following gravel or macadamized roads in Marshall Township: Trogden Lane, length 7,060 ft.; Guthrie and Limestone Road, 12,825 ft.; Peerless Road, 16,786 ft.; Guthrie and Bartlessville Road, 4,666 ft.; the Dunn-Anderson branch of the Peerless Road, 4,760 ft.; Brinegar Lane, 2,800 ft.

Bloomfield, Ind.—It is reported that bids will be received Mar. 16 by the Co. Comrs. for constructing gravel and macadamized roads in Stockton and Wright Townships.

Rockville, Ind.—It is reported that bids will be received Mar. 7 by T. A. Garrard, Chmn. Co. Comrs., for improving and constructing 4 distinct gravel roads.

Bedford, Ind.—Bonds amounting to $44,-680 are reported sold for constructing gravel roads in Lawrence County.

South Bend, Ind.—The Bd. of Pub. Wks. is stated to have adopted resolutions providing for the paving with brick on portions of the following streets: Studebaker, Scott, Laurel, Robertson, E. Monroe and Hill Sts.

Rensselaer, Ind.—Jas. N. Leatherman, Co. Aud., writes in regard to the construction of about 13 miles of gravel road in Gillam Township, bids for which were to have been opened on Feb. 7, that no award was made, the matter being postponed until the March term.

Indianapolis, Ind.—The lowest bid opened on Feb. 10 by the Park Comrs. for the construction of Fall Creek Boule., was submitted by the Moore-Mansfield Co., of Indianapolis; amount of bid reported to be $62,850.

**Vincennes, Ind.*—The Comrs. of Knox County are reported to have awarded the contract for building the Johnson Township gravel road to Geo. M. Albertson, for $47,-439.

Sioux City, Ia.—It is proposed to lay about 100,000 sq. yd. paving; material to be used probably brick and asphalt. J. M. Lewis, City Engr.

Des Moines, Ia.—It is stated that bids will be received Feb. 28 by the Bd. Pub. Wks. for curbing with Portland cement on Newcomb Ave., in all about 2,031 lin. ft.

Promise City, Ia.—Bids will be received Feb. 21 by the Township Trus. for South Fork Township road work for year 1905. Harry Chrisman, Township Clk.

**Baltimore, Md.*—The contract for paving with asphalt block on a portion of Evergreen Terrace is stated to have been awarded to the Maryland Pavement Co., Equitable Bldg., at $2 per sq. yd., or a total cost of $8,000.

The widening of Light St. at a cost of $750,000, is reported under coinsideration.

Baltimore, Md.—See "Sewerage and Sewage Disposal."

Detroit, Mich.—Bids will be received Feb. 27, by the Dept. Pub. Wks., for furnishing and delivering f. o. b. at municipal asphalt plant in city's Western Dist. yard, about 5,000 cu. yds. binder stone, 600 tons limestone dust and 6,500 cu. yds. sand for sheet asphalt paving mixture in said city; also for furnishing and delivering f. o. b. about 1,000 tons asphalt for sheet asphalt paving purposes and 500 tons eastern petroleum, Texas or California oils, suitable for fluxing refined asphalt oil for paving purposes. Wm. H. Maybury, Comr.

**St. Paul, Minn.*—Fielding & Shepley, 217 W. University Ave., are stated to have received the contract for reflooring and paving 3d St. bridge over C. N. & N. P. Rys., for $10,320 (bids opened Feb. 2).

**Webb City, Mo.*—W. E. Smith, City Engr., writes that A. F. Franks, of Jacksonville, Ill., has secured the contract for 18,000 sq. yd. brick paving (bids opened Feb. 6), at $1.71 per sq. yd.

New Brunswick, N. J.—The Council has passed the ordinance providing for the grading, curbing and paving of Handy St. with brick, at a cost of $10,000. Asher Atkinson, City Engr.

Deal Beach, N. J.—See "Sewerage and Sewage Disposal."

Kingston, N. Y.—Bids are wanted Feb. 21 for $26,000 road improvement bonds. Archibald McLaughlin, Co. Treas.

New York, N. Y.—Bids will be received until Feb. 28 by Louis F. Haffen, Pres. Bronx Boro., for completing the contract recently abandoned for the grading, curbing, flagging sidewalks, laying cross walks, etc., on Fulton Ave. from St. Paul's Place to E. 171st, and a similar contract on Trinity Ave. from Westchester Ave. to Dater St., work to include 7,750 cu. yd. earth excavation, 11,400 cu. yd. rock excavation, 4,400 cu. yd. filling, 8,550 lin. ft. new curbstone furnished and set, 32,800 sq. ft. new flagging furnished and laid, 1,500 sq. ft. old flagging rejointed and relaid, etc.

Rochester, N. Y.—The Bd. of Contract is stated to have rejected all bids received for paving First St., and, according to reports, new bids will be received. Whitmore, Rauber & Vicinus, 279 South Ave., and H. N. Cowles, 47 Tacoma St., are reported to have submitted the lowest bids: for asphalt, $26,168, and brick, $26,310, respectively.

Buffalo, N. Y.—The lowest bids received by the Dept. Pub. Wks. on Feb. 9, for paving portions of several streets, are stated to have been as follows: Clinton St. from Bond to Smith St., and Court St., German Rock Asphalt & Cement Co., D. S. Morgan Bldg., $3,194 and $2,499, respectively; Ellicott and Exchange Sts., Barber Asphalt Paving Co., 880 Ellicott Sq., $1,650 and $11,620, respectively, and Whitney Pl., H. P. Burgard, Prudential Bldg., $3,400.

Albany, N. Y.—A bill is stated to have been introduced in the Assembly on Feb. 8, providing for an appropriation of $5,000,000 to meet the share of the State in good roads improvements.

Syracuse, N. Y.—Bids will be received Feb. 20, by the Bd. Contract and Supply for furnishing material and paving with sheet asphalt or asphalt block, or with vitrified brick or block, portions of Eliott and Marshall Sts.; requiring a maintenance guarantee of 10 years. Geo. J. Metz, City Clk.

**Cortland, N. Y.*—The Bd. of Pub. Wks. is stated to have awarded paving contracts as follows (bids opened Jan. 26): Tompkins St., to Barber Asphalt Paving Co., of Buffalo, $12,094; Owego, Elm Sts. and Maple Ave., to Warner-Quinlan Co., of Syracuse, for $13,173, $36,549 and $6,375, respectively.

Elmira, N. Y.—An appropriation of $11,000 has been made for new pavement to be laid during 1905.

Geneva, N. Y.—Bids will be received by the Bd. of Pub. Wks. on Feb. 23 for paving with brick, macadam, tar macadam, asphaltic macadam and asphalt, as advertised in The Engineering Record.

Toledo, O.—Bids will be received until Feb. 28 by the Bd. Pub. Service for repaving a portion of Jefferson Ave., and for improving portions of Idaho, Water, and Winthrop Sts. by paving with either vitrified paving block, asphalt block, Medina block stone or creosoted wood blocks, bitulithic or bituminous macadam pavement laid on a concrete, sand or broken stone foundation. Harry S. Jones, Secy.

Columbus, O.—Bids will be received Feb. 24 by the Bd. Pub. Service for grading, curbing and paving with asphalt, hard-burned brick or block, macadam or other substantial material portions of 4 streets; also for grading, curbing and paving with hard-burned brick or block portions of 16th Ave. and Schiller St., and with hard-burned brick a portion of Worthington St. Chas. H. Frank, Secy.

Covington, O.—The City Council is stated to have decided to pave several streets with brick at a cost of $32,000.

**Mt. Gilead, O.*—Wm. F. Wieland, Village Clk., writes that grading and paving with brick or block on a portion of High St. (bids opened Feb. 8) has been awarded to W. H. Raymond & Co., of Galion, for $7,622.

Ironton, O.—J. R. C. Brown, City Engr., writes that bids have not yet been asked for the paving of 3d St. with brick, and may not be before April.

Cleveland, O.—The Cleveland Trinidad Paving Co. submitted the lowest bids on Feb. 8 for brick paving as follows: Francis St., for $10,524; Congress St., $10,051; Brooker Ave., $11,341; Bazetta St., $17,441, and for 31 other streets, at a total of about $140,000.

**Toledo, O.*—The Bd. Pub. Service is stated to have awarded the following paving contracts (bids opened Jan. 26): Lawrence Ave. with Logan brick, to Kerlin Bros., 416 Nasby Bldg., for about $6,668; Baker St. with grouted Twentieth Century block and Wabash St. with same material, to H. P. Streicher, for $6,710 and $5,100, respectively, and Winthrop St. with Buckeye block, to Wm. McMahon, Jr., 321 Floyd St., for $5,792.

Middletown, O.—See "Sewerage and Sewage Disposal."

Cincinnati, O.—The following are the bids opened on Feb. 8 by the Bd. of Pub. Service for furnishing material and resurfacing with asphalt a portion of N. Court St.: Kirchner Constr. Co., $2,339; Blake Asphalt Maintenance Co., $2.224, and Barber Asphalt Paving Co., $2,263.

Bids will be received Feb. 24 by the Bd. Pub. Service for furnishing material and improving a portion of Clark Ave. by grading, curbing and macadamizing roadway and constructing necessary drains and retaining walls; bids will also be received Mar. 10 for furnishing material and resurfacing with asphalt a portion of Central Ave. Geo. F. Holmes, Clk.

Nashville, Tenn.—W. W. Southgate, City Engr., is stated to have estimated the cost of extending Commerce St., at $178,000.

**Tacoma, Wash.*—Tisher & Scott are stated to have received the contract for grading and laying walks on a portion of S. 27th St., for $5,925.

**Seattle, Wash.*—The following are the bids opened on Feb. 4 for planking Hanford St. (bidders all of Seattle): Zeringibel & Marshall, $16,842; Stirrat & Goetz, $15,696; Puget Sound Bridge & Dredging Co., $18,329; L. H. Goerig, $15,097 (awarded contract); C. Geste, $16,386; American Pile Driving Co., $19,954; F. McLellan & Co., $19,422; A. Thorsvig & Co., $16,392; Geo. W. Walker, $16,587; J. A. Bailey, $21,058. L. H. Goerig, the successful contractor, bid for 34,400 lin. ft. piles, 9½ cts. per lin. ft., and 9,400 lin. ft. fence, 10 cts. per lin. ft.

*Stirrat & Goetz, 410 Washington Blk., have secured the contract for planking Holgate St., for $13,905.

Beloit, Wis.—Robt. Caldwell, City Engr., is preparing plans for about ¾ of a mile of brick paving with stone curbing.

San Juan, Porto Rico.—The Acting Comr. of Interior of Porto Rico, in his recommendations to the Legislative Assembly now in session, has asked $200,000 for the maintenance and repair of roads and bridges for the fiscal year 1905-6.

Cleveland, O.—The following are the bids opened on Feb. 8 by the Bd. of Pub. Service for paving Woodland Hills Ave., from Meech St. to Miles Ave.; (*a*) Cleveland Trinidad Paving Co., (*b*) Standard Paving Co., (*c*) Roehl Bros., (*d*) Northern Ohio Paving & Constr. Co., (*e*) Baldwin Bros & Graham:

	a.	*b.*	*c.*	*d.*	*e.*
3,280 cu. yd. excav. or embankment........	$0.40	$0.40	$0.40	$0.50	$0.45
75,000 sq. ft. concrete foundation laid.....	.07	.07	.07	.07	.07
75,000 “ brick pavement laid.	.14¾	.15¼	.15¼	.15¼	.149
4,700 lin. ft. 5-in. Medina curb set........	.70	.70	.65	.65	.70
200 “ curbstone reset	.08	.10	.08	.10	.10
19 new catch basins.................	35.00	40.00	40.00	40.00	45.00
800 lin. ft. 12-in. catch basin pipe......	.90	.75	.80	.75	.80
500 “ sewer built.	1.25	1.25	1.35	1.25	1.25
2,000 sq. ft. 3-in. new flag fur. and laid...	.16	.15	.15	.15	.15
2,000 “ flag relaid.	.04	.02	.02	.02	.02
800 lin. ft. French drains	.30	.35	.30	.30	.30
Total	$23,711	$24,094	$23,980	$24,146	$24,104

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Sylacauga, Ala.—Bonds to the amount of $24,000 are reported sold, to be used for the construction of an electric light plant, and water works.

Pocahontas, Ark.—S. C. Dowell, of Walnut Ridge, is reported interested in the construction of a $25,000 electric light plant at Pocahontas.

Greeley, Colo.—The Greeley Gas & Electric Co. has been incorporated, with a capital of $50,000, by Chas. E. Ramsay, Martin A. Bunker, Burton D. Sanborn and others.

Washington, D. C.—Bids will be received Mar. 14 at the Bureau Supplies and Accounts, Navy Dept., Washington, for furnishing at navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of electrical wire, blow pipe, builders' hardware, pig iron, wrought iron, incandescent lamps, electrical cable, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

Elgin, Ill.—The Elgin Hydraulic Co. is reported interested in the construction of a power plant at Elgin.

East St. Louis, Ill.—The East St. Louis Consumers' Electric Light, Power & Heat Co., of East St. Louis, has been incorporated, with a capital of $75,000, to furnish light, heat and power. Incorporators: H. J. Dehaan, Fred W. Zegenheim and Chas. O. Clark.

The St. Clair Light & Power Co., of East St. Louis, has been incorporated, with a capital of $75,000, to furnish electric light and power. Incorporators: C. L. Gray, H. C. Barnard and R. W. Sikking.

Aurora, Ill.—The Aurora Mfg. & Lighting Co., of Aurora, has been incorporated, with a capital of $12,000, to manufacture and furnish light, heat and power. Incorporators: Percy G. Lincoln, F. W. Detray and T. J. Helphrey.

Lockport, Ill.—Bids will be received by the Trus. of the Sanitary Dist. of Chicago (Zina R. Carter, Pres., Chicago) on Apr. 12 for the construction of a power house for the Lockport power development near Lockport, on the extension of the main drainage channel, as advertised in The Engineering Record.

Items marked thus give the names of parties awarded contracts.

Monmouth, Ill.—The Monmouth Gas & Electric Co. (Sinclair Mainland, Treas.) is reported to be preparing plans for a coal gas works, the extension of the gas mains and repairs and extension to the electric light plant.

Madill, Ind. Ter.—The Town Council is reported to have granted a franchise to F. W. Porter, of Whitehall, Wis., for an electric light plant.

Sioux City, Ia.—A charter has been granted to Tilden & McRoberts, of Chicago, Ill., for a lighting, heating and power plant; under the terms of the franchise $100,000 must be expended within a year.

Pittsburg, Kan.—A franchise to establish an electric-light plant is reported to have been granted to Morris Cliggitt.

Cloverport, Ky.—The Cloverport Water, Light & Ice Co. has been incorporated, to construct water works, an electric-light plant and ice plant. A. L. Fort and Lee E. Cralle, both of Louisville, are reported to be among the incorporators.

Abbeville, La.—Geo. W. Summers, Secy. of Council, writes that it is proposed to construct water works, electric light plant and sewerage system, and the taxpayers will shortly vote on the question of issuing $45,000 bonds for same.

Shreveport, La.—It is stated that bids are wanted Apr. 11 for electric lighting said city for periods of 5 and 10 years. C. G. Rives, Compt.

Worcester, Mass.—C. T. Sherer and Geo. Crompton are reported interested in the construction of an electric plant to supply light and power for the buildings in the square bounded by Main, Front, Commercial and Mechanic Sts.

Hastings, Mich.—John Ott and Seymour Y. Hill, of Albion, and Fred. Freese, of Ft. Wayne, Ind., are stated to have secured a franchise for a gas plant.

Ludington, Mich.—The Ludington Gas Co. has been incorporated, with a capital of $75,000, by Chas. A. Coye, B. E. West, O. F. Burkhart, and others.

Grosse Pointe Farms, Mich.—The Village Council is reported to have under consideration installation of an electric light plant.

Stillwater, Minn.—Bids will be received by the Stillwater Gas & Electric Light Co., 234 S. Main St., on Mar. 10 for the construction of a gas plant.

Seminary, Miss.—The Mason Lumber Co., of Platt Station, is stated to have decided to construct an electric-light plant. It will also furnish lights for Seminary.

Sturgeon, Mo.—The citizens are reported to have voted Feb. 6 to issue bonds for the construction of an electric light plant.

Ft. Benton, Mont.—The Benton Electric Light Co. is reported incorporated, with a capital of $15,000.

Bayonne, N. J.—The Council is stated to have adopted a resolution providing for the appointment of a committee, consisting of Messrs. Bannon, Cronin, Wilson, Nugent and Cassidy, to consider the question of constructing a municipal electric light plant.

Passaic, N. J.—The City Council is reported to have under consideration the establishment of a municipal lighting plant, and will probably petition the Legislature for permission to do the work.

Las Cruces, N. M.—The Las Cruces Electric Light & Ice Co. has been incorporated, by Ben L. Berkley, Jos. Wilkinson, of El Paso; Theo. Rouault and Herbert B. Holt, of Las Cruces, with a capital of $50,000.

New York, N. Y.—Mayor McClellan presented to the Bd. of Estimate on Feb. 10 plans suggested by Cary T. Hutchinson, Geo. F. Sever and Nelson P. Lewis, the committee recently appointed to consider the matter of establishing a plant for electric lighting the Boroughs of Manhattan and the Bronx. They estimate the total cost of a system capable of serving 6,000 arc lamps and 250,000 16-c.-p. incandescent lamps at about $4,100,000 exclusive of the cost of real estate; total cost of annual operation is $906,000.

**Buffalo, N. Y.*—The committee on military affairs of the Bd. of Superv. on Feb. 13 decided to report in favor of awarding the contract for the electrical work on the new 65th Regt. Armory (bids opened Jan. 31) to McCarthy Bros. & Ford, for $89,950.

Rochester, N. Y.—Bids will be received Feb. 24, by the Bd. Educ., for electric work, installing a motor generator set and furnishing and installing laboratory switchboards with instruments in West High School. J. Foster Warner, Archt., 1036 Granite Block. J. S. Mullan, Secy.

Governor's Island, N. Y.—Bids are wanted Feb. 23 (readvertisement) for wiring quartermaster's storehouse and wharf buildings for electric light and power; constructing trolley and feeder system; for furnishing, installing and connecting motors, locomotive, switch-board and ventilating fans, and all controlling appliances; also furnishing and installing an electric elevator, with all controlling appliances here. Maj. G. S. Bingham, Q. M., U. S. A., Army Bldg., Whitehall St., New York.

Crystal, N. D.—W. J. Fahey, City Aud., writes that C. A. Appleton is interested in the construction of a gas plant.

Steubenville, O.—Frank S. King, City Aud., writes that the council has under consideration the question of submitting to a vote of the people at the spring election, the construction of a municipal electric light plant, to cost $180,000.

Urbana, O.—Frank P. Torrence is stated to have petitioned for a franchise for a hot-water heating and electric-light plant.

Miamisburg, O.—Bonds to the amount of $19,000 are reported sold to be used for the merging of the electric-light plant and water works into one.

Lorain, O.—Press reports state that the Bd. of Pub. Service has asked for estimates for machinery, etc., for a small municipal electric light plant, with sufficient power to supply lights for city buildings.

Norwalk, O.—Bids will be received until Mar. 21 by the Bd. Pub. Service for furnishing the necessary lights for a period of 10 years to properly light the public places, streets, avenues and alleys, with either gas or electric lamps, or a combination of them. T. P. Kellogg, Clk.

Prairie City, Ore.—Dr. Carlton Faull and Alfred Curry, of Baker City, are reported to be negotiating for the purchase of the Prairie City electric-light plant. If purchased, about $25,000 will be expended for improvements. They will also construct water works.

..*Yoe, Pa.*—E. R. Hersey is stated to have petitioned Boro. Council for a franchise for a new lighting company, which will supply Dallastown, Red Lion, Windsor and Yoe with electricity.

West Scranton, Pa.—An application is about to be made to the governor for a charter for the West Scranton Light, Heat & Power Co., by Wm. T. Davies, John H. Williams, Herbert L. Taylor and others, all connected with the West Scranton bank. It is understood that the company proposes to operate mainly in West Scranton.

Middleburg, Pa.—Geo. W. Wagenseller, of Middleburg, and David Goldstein, of Pittsburg, are stated to have secured a franchise for the construction of a power plant on Middle Creek below Selinsgrove. A company with a capital of $50,000 will be incorporated, and the power developed and transmitted in Snyder County.

**Bridgeport, Pa.*—The Norristown Electric Light Co., of Norristown, is stated to have secured the contract for lighting the streets by electricity at $70 per lamp per yr.

Clinton, S. C.—Engr. Chas. C. Wilson, of Columbia, writes that no date has yet been fixed for the opening of bids for the proposed water-works and electric-light plant. A previous item stated bids would be received about Feb. 15.

Branchville, S. C.—G. M. Noble, City Clk., writes that bids are now being received for an electric-light plant and telephone exchange, to cost about $6,000.

Watertown, S. D.—H. D. Rice, City Clk., writes that Chas. Patterson and Thos. McDermott, of St. Paul, Minn., have secured a franchise for the construction of a gas plant.

Montrose, S. D.—It is reported that Mark Donahue and P. G. Williams will install an electric-light plant at once.

San Angelo, Tex.—U. G. Taylor, of San Angelo, is reported interested in the construction of an electric-light plant at Angelo Heights.

Park City, Utah.—Henry Shields and associates are stated to have secured a franchise to furnish electric light and power in this city.

Ft. Douglas, Utah.—It is proposed to light Ft. Douglas by electricity, power to be furnished by the Utah Light & Ry. Co.

Charleston, W. Va.—The Triple Plate Natural Gas & Oil Co., and the Kanawa Natural Gas Co., which supply cities and towns in Ohio, West Virginia and Kentucky, are reported to have been merged into the U. S. Natural Gas Co., having a capital of $6,000,000. The two principal cities supplied are Huntington and Charleston, W. Va. Improvements to the extent of about $500,000 are reported to have been decided upon and will include the extension of a line to Portsmouth, and the laying of another line to Huntington. Directors: O. D. Bleakley, Franklin, Pa.; E. H. Gary, of New York, N. Y., and others.

Harper's Ferry, W. Va.—Stevenson A. Williams, of the Martinsburg Electric Co., Martinsburg, W. Va., is reported interested in a new company which proposes purchasing the old pulp mills near Harper's Ferry, where an electric plant is contemplated.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Hartford, Conn.—The Hartford St. Ry. Co. is reported to have petitioned State Legislature for permission to increase its capital from $2,000,000 to $5,000,000, and asks an extension of time to July 1, 1907, in which to build from Broad St., Hartford, to Wethersfield. The increase in stock is to be used for general improvements to the system, among which is considerable track work, the building of a power house, and the erection of repair shops and car houses.

Lithonia, Ga.—The Atlanta & Carolina Electric Ry. is reported to be surveying its line, under the charge of M. Mason, Chf. Engr. of Montgomery, Ala. The distance surveyed is from East Atlanta to Lithonia, 17¼ miles.

Alton, Ill.—Attorneys for the Alton, Granite City & St. Louis Traction Co. and the Alton, Jacksonville & Peoria Electric Ry. Co. are reported to have agreed upon a joint franchise for the two companies, with the understanding that the proposed system should be in operation within one year from date.

Lexington, Ky.—The Fayette Traction Co. is reported to have purchased the holdings and franchises in Woodford County held by Clifford D. Bebee, of Syracuse, N. Y., and the interurban electric line between this city and Versailles will be built the coming summer by local capital.

Pittsfield, Mass.—Bids will be received until Mar. 15 by P. H. Dolan, Pittsfield, for constructing the Bennington and North Adams St. Ry., and also the extension to the Hoosic Valley St. Ry. Work to include approximately on the Bennington and North Adams Ry.: Earthwork, 114,575 cu. yd. cuts and 96,757 cu. yd. fills; rock, 4,222 cu. yd. solid, and 4,014 cu. yd. loose; 2,586 cu. yd. masonry, 12 bridges, and 51,112 cu. yd. ballast, and on the Hoosic Valley Ry., 3,700 ft. of track and overhead work connecting with the above. Plans, specifications, etc., may be seen at the office of Durkee, White & Towne, Engrs., Rm. 8 and 9, 292 Main St., Springfield.

Excelsior, Minn.—F. E. Kenaston, E. J. Phelps and others, of Minneapolis, have been granted a franchise for an electric railway through the village. They are understood to be interested in the projected line from Mankato to St. Peter and Chaska to the Twin Cities.

**Lexington, Miss.*—The Durant-Lexington Electric Ry. Co. is reported organized, and the contract for construction is reported to have been let to the Louis Monteville Constr. Co., of Mississippi. Chester Jones and W. O. Glines, of Durant, are reported interested.

Jackson, Miss.—It is reported that Frank G. Jones, of Memphis, Tenn., Prest. of the Jackson St. Ry., Light & Power Co., is soon to return to Jackson from New York, and will make public plans for a number of important improvements to the local system.

St. Joseph, Mo.—A franchise is stated to have been granted by the County Court to the St. Joseph & Maryville Electric Ry. Co. to build from the line between Andrew and Buchanan Counties to St. Joseph. There will be about 2¾ miles of road in this county.

Malone, N. Y.—The Paul Smith Hotel Co. is reported to have bought out the Saranac Lake Light, Heat & Power Co., the capital of which is $100,000. Power from this plant will be used for operating the electric railway to be built between Lake Clear Junction and the Paul Smith Hotel, located on St. Regis Lake.

New York, N. Y.—Press reports state that plans are being prepared for the building of a subway by the Belmont interests, from 42d St. to Long Island City, to connect with the line of the New York & Queens County Ry. Co.

Columbus, O.—It is reported that the Columbus, Urban & Western Traction Co. has secured rights of way and construction will be continued as soon as the weather permits.

Mt. Vernon, O.—Plans for the construction of the Cleveland, Wooster, Mt. Vernon & Columbus Ry. are stated to have progressed sufficiently to insure the building of the line, and it is stated that work will begin as soon as weather permits. F. W. Jones, Pres., and J. A. Tilton, Secy., both of Mt. Vernon.

Delaware, O.—The Delaware & Magnetic Springs Railway Company is planning to extend its line from Magnetic Springs to Richwood. The right of way has been secured, and work will start as soon as the weather permits. J. B. Taggert, of Delaware, Gen. Mgr.

Barberton, O.—The Barberton, Wadsworth & Western Traction Co. is reported organized, with B. M. Clendening, of Cincinnati, Pres., and O. D. Everhard, of Barberton, Secy; J. Edw. Collin, of Barberton, Ch. Engr. The company expects to build from Barberton to Wadsworth, and later to Seville or Creston. Construction work will probably start in the spring.

Columbus Grove, O.—A franchise through this village is stated to have been granted to Jos. B. Maver and others interested in the Lima Ry., Light & Power Co., who propose to build a line from Lima to Toledo, paralleling the Cincinnati, Hamilton & Dayton R. R.

Massillon, O.—The Canton-Akron Ry. Co. is stated to have decided to install a substation at Massillon, placing in it a 300-kw. rotary. It is stated that a large turbo-generator will be placed in the main power station.

Springfield, O.—John L. Plummer and D. K. Gotwald, of Springfield, are reported to have interested New York capital in their proposed line from Springfield to Clifton, Cedarville, Jamestown and Wilmington. Entrance to Springfield will be made over the tracks of the Springfield & Xenia Traction Company's line from Yellow Springs. Work on the line will probably start in the spring.

Celina, O.—The Indianapolis, Hartford City & Celina Traction Co. is reported to have applied for a franchise in Celina. The line would complete a short electric route between Indianapolis and Toledo.

Toledo, O.—The Toledo & Indiana Ry. Co., which is building an extension to Bryan, is considering the extension of the road from Bryan to Ft. Wayne, Ind. The Patrick Hirsch Constr. Co., of Toledo, is doing the construction work.

Zanesville, O.—The Zanesville Ry., Light & Power Co. is reported to have secured a franchise for a loop around 6th, 8th, South and Main Sts., in the heart of the city.

C. B. Hart and Alfred Caldwell are reported to be at the head of the syndicate furnishing the financial backing for the Southeastern Ohio Ry., Light & Power Company's line. Work on the line from Zanesville to Crooksville will probably start in the spring.

Lisbon, O.—Right of way men said to r resent the Stark Electric Ry., are reported be working on the route between Salem a Lisbon.

Steubenville, O.—A company has b formed by D. H. Sinclair, Cyrus Fergus J. T. Douglas and others of Steubenville, build an electric railway from Steubenv to Wellsburg, W. Va., where connection be made with the Pan Handle Traction for Wheeling. Contracts will probably so be let.

Sandusky, O.—It is stated that J. C. P ker, chief promoter of the Sandusky, Clyd Tiffin Ry., has arranged for financing proposition.

Portland, Ore.—Right of way is repor to have been secured for an extension of Oregon Water, Power & Ry. Co. from Ced ville, 2 miles west of Gresham, to Colum River, opposite Washougal, through Fairvi and Troutdale.

California, Pa.—A charter is reported have been granted to the California St. R Co., with a capital of $25,000, to build electric railway through California.

Danville, Pa.—Negotiations are reported be in progress between the Danville & Bloom burg St. Ry. Co. and the Danville & Sunb St. Ry. Co., which, if agreed upon, will ena the latter to use part of the rights, franchis and property of the former; also to perm the Danbury & Sunbury Co. to build on Market St., Danville.

**Jeannette, Pa.*—The Jeannette, West Ne ton & Monongahela Valley St. Ry. Co. is ported to have granted the contract for building of a line from Jeannette to We Newton to the New England Eng. Co., Waterbury, Conn. The line will be about miles long, and will pass through Ed Arona, New Madison and Herminie.

Elizabethtown, Pa.—The Council is sta to have passed an ordinance granting a fra chise to the Philadelphia, Lancaster & Ha risburg Electric Ry. Co.

Tamaqua, Pa.—Preliminary surveys are ported under way for the extension of t Tamaqua & Lansford St. Ry. from Tamaq to Middleport.

Easton, Pa.—The Bangor & Portland R Co. is stated to have decided to commence the spring the construction of a line to Del ware Water Gap.

Gettysburg, Pa.—P. Russ is reported to chief promoter of the Gettysburg-Mt. Hol Springs Electric Ry., which will probably built during the summer.

Lancaster, Pa.—A charter of the Lancast & Safe Harbor Electric Ry. Co. has been corded here. The line will be 9 miles lo extending from South Queen St. to Safe H bor via Sonestaga Centre; capital, $54,0 Henry M. Stauffer, Pres.

Scranton, Pa.—An ordinance granting franchise to the Northern Electric St. Ry. is reported to have been introduced in Co cil. The company, in which former Ma W. L. Connell is interested, desires to bu a line on W. Market St. between N. M Ave. and the city line, with possibly an tension to Dalton.

Butler, Pa.—An ordinance granting Pittsburg & Butler St. Ry. Co. a franc is reported to have been adopted by Coun

Watertown, S. D.—H. D. Rice, City C writes that the Watertown Transporta Co. has secured a franchise for a street way. A. L. Rowe, Mgr.

Nashville, Tenn.—The Nashville & Hu ville Ry. Co., with offices at 16-19 St Bldg., Nashville, is reported incorporated build an electric railway from Nashville Huntsville. J. H. Connor, Pres.; W. Frickling, Secy.

Spokane, Wash.—A. M. Lupfer is repo to be here as Constructing Engr. of Spokane & Inland Ry. in building its prop electric line from Spokane to Moscow, Id

Walla Walla, Wash.—Articles of rein poration of the Walla Walla Ry. Co., wi capital of $500,000 are reported to have filed with the County Auditor, naming E Isaacs, F. E. Smith, Grant Copeland and O'Donnell as the incorporators. The art provide for the building and equipping operating of a street railway in Walla W and suburbs, an interurban railway in Or and Washington, with the right to acc lands and franchises, to build and main electric light and power plants, to acc water rights and to do business properly longing to a general electric light and p plant.

Wheeling, W. Va.—The Stillwater & W ing Valley Traction Co. is reported fo to build from Uhrichsville, O., to Pasco connect Canton, O., with Wheeling. Dr. Hobson, Pres. The road will touch water, Pannock, St. Clairsville and Pasco

Vancouver, B. C.—An agreement is re ed to have been reached between the Cana Pacific Ry. Co. and the British Colu Electric Ry. Co., under which the latter operate the Lulu Island Branch Ry. bet Vancouver and Steveston, on the Fraser R The road will probably be electrified.

Montreal, Que.—The Lonquenil Tran Co. is reported to be seeking incorporati build an electric railway from Montre Lonquenil and through other parishe Chambly County.

Items marked thus give the names of parties awarded contracts.

RAILROADS.

Arranged Alphabetically by States.

olia, Ark.—A committee of citizens ed of J. O. Hutcheson, W. W. Boyd, Cross, and others, has been appointed it subscriptions for a railroad which C. Gordon will construct from Mag- either Stamps, Hope or Prescott.

loom, Ga.—A charter has been grant- he Ocilla, Pinebloom & Valdosta Ry. construct a line from Satilla River via ochee, Pinebloom and Nashville to Incorporators: B. B. Gray, of Pine- Geo. F. McCranie, and Henry Paul, Villacoochee, and others; capital stock, 00.

nington, Ill.—Plans are reported to een completed for double-tracking the & Alton R. R. from Bloomington to n, a distance of 51 miles. G. H. Kim- h. Engr., Chicago.

on, Ill.—H. U. Wallace, of Chicago, gr. of the Illinois Central R. R. Co., is to have recommended the expenditure een $1,000,000 and $2,000,000 on im- the road bed of the company this nd most of this, it is understood, will it in lowering the grades and straight- he curves of the railway between Clin- d Freeport.

Moines, Ia.—Local press reports state ontracts will be let early in March for nstruction of the St. Joseph, Albany Moines R. R.

gor, Me.—The Bangor & Northern Short Line Ry. Co. is reported formed, capital of $5,000,000, to build a 275- ailroad from Bangor to and through ook County. Incorporators: John D. s, of New York, N. Y.; Edwin A. , of Trenton, N. J.; Geo. W. Maxfield, gor, and Herbert H. Heath, of Augusta, hers.

tiesburg, Miss.—The Mississippi Cen- ailroad Co. (L. L. Major, Vice-Pres., sburg) has by amendment increased its l from $50,000 to the total of $1,500,- or the purpose of making extensions of ad, the purpose being to go to Mississ- iver on the west and to the Gulf Coast south.

urn, N. Y.—The New York, Auburn & g R. R. Co., a steam road which it is sed to build from Auburn to Ithaca, is ed to have made application to the Board of R. R. Comrs. for the issue of mortgage of $1,000,000, and for a de- ation as to how the road shall cross racks of the Lehigh Valley R. R., at point along the route of the new steam

acuse, N. Y.—The Delaware, Lacka- a & Western R. R. Co. (H. H. Shepard, Supt., Syracuse) is reported to have de- to expend about $75,000 in Syracuse g the coming summer in improvements, ling the erection of a new roundhouse, emodeling of the yards and the construc- of a coal elevator.

rham, N. C.—Surveyors are reported to orking on the Durham & Southern R. R., will run from here to Apex, and there ect with the Seaboard Air Line and the r Road.

ledo, O.—See "New Industrial Notes."

ungstown, O.—Arrangements for raising 0,000 to build the Cleveland, Youngs- & Eastern R. R. are reported to have made by Youngstown and Cleveland . The company has planned a new steam 50 miles long, running through Moran oungstown, around which it will skirt as t line. It will then run to Struthers.

od River, Ore.—D. Eccles, of Ogden, , Pres. Sumpter Valley R. R. Co., is re- d interested in the construction of a railroad in Hood River Valley, about 17 in length.

wcastle, Pa.—Press reports state that racts will soon be let by the Pittsburg, emer & Lake Erie R. R. Co. (J. A. At- l, of Pittsburg, Ch. Engr.) for the exten- of its Western Alleghany line from n Junction to Newcastle, a distance of t 28 miles.

id, Okla. Ter.—The Enid, Beaver. Guy- & Western R. R. Co. has been incorpo- l, with a capital of $5,000,000, to build e from Enid to Lawson, N. M. Directors: 3. Quinn and J. C. Williamson, Guymon; . Brainword, Beaver; W. I. Drummond, l, and others.

. Worth, Tex.—Press reports state that Colorado & Southern Ry. Co. (H. W. an, Ch. Engr., Denver, Colo.) is consider- he extension of its line from Ft. Worth to eston.

rattleboro, Vt.—It is stated that the Cen- Vermont R. R. Co. (J. M. Morrison. of Albans, Vt., Engr. & Supt. of Structure) rebuild the Brattleboro & Whitehall R. R., a narrow gauge road 35 miles long be- en Brattleboro and South Londonderry, as andard gauge road.

harleston, W. Va.—Bids will be received il Mar. 1 by Gen. Mgr. of the Imboden & ll R. R. Co. (C. P. Peyton, Ch. Engr., rleston), for constructing 11 miles of ex- sion of the line on Blue Creek, W. Va.

heboygan, Wis.—Preliminary arrange- ts for the building of the new short line he North-Western R. R. (E. C. Carter, Ch. r., Chicago, Ill.), between Manitowoc and ette, by way of Green Bay, are now in gress. The road will strike the old Ash- l division tracks at Two Rivers Junction, it is reported that a large viaduct will constructed at this point.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Gadsden, Ala.—A Carnegie Library is to be erected here at a cost of $10,000.

Little Rock, Ark.—It is reported that the State Bd. of Charitable Institutions has authorized bids to be received until Mar. 9, at the office of John H. Page, Secy., for erecting a dormitory at the Deaf Mute Institue, to cost about $45,000. Frank W. Gibb, Archt., 112 Louisiana St.

Hot Springs, Ark.—Bids will be received until Mar. 7 by Geo. H. Lower, Bldg. Comr., for erecting a court house, exclusive of heating, plumbing, and lighting. Estimated cost, $100,000. Plans may be secured from the archts., W. R. Parsons & Son, Des Moines, Ia.

Batesville, Ark.—The following are the 5 lowest bids opened on Feb. 14 by the Superv. Archt., Treas. Dept., Washington, D. C., for a low-pressure steam-heating apparatus for the U. S. Post Office and Court House at Batesville: E. J. McDonough, Chicago, Ill., $3,695; Sodeman Htg. & Plumbing Co., St. Louis, Mo., $3,620; Liddell Htg. & Plumbing Co., Montgomery, Ala., $3,786; Southern Htg. Co., Memphis, Tenn., $3,870, and Iowa Mfg. Co., Oskaloosa, Ia., $3,971.

Ft. Baker, Cal.—Bids are wanted Mar. 8 for constructing, including plumbing, heating and electric wiring a barrack for one company of coast artillery at this post. Capt. W. C. Wren, Q. M., U. S. A., Phelan Bldg., San Francisco.

Silverton, Colo.—It is reported that a $40,000 court house is to be erected here in the spring.

**Washington, D. C.*—The following are the bids opened on Feb. 11 for the erection of an engine-house at Virginia Ave., 8th and 9th Sts.: J. M. Dunn, Washington, $18,243 (awarded contract); Meads & Reynolds, $18,300; W. E. Mooney, $18,658; Gleeson & Humphrey, $18,950, and Burgess & Parsons, $19,697.

**Ocala, Fla.*—S. T. Sistrunk, Clk. Circuit Court, writes that the contract for erecting a court house (bids opened Feb. 6) has been awarded to McIver & McKay, of Ocala, for $48,987.

Goshen, Ind.—The following are reported to be the bids opened by the Co. Comrs. on Feb. 1 for repairing the court house: Frank Miller, Goshen, $56,190; P. H. McCormick & Co., Columbus, Ind., $46,445; H. G. Christman & Co., South Bend, $48,825; J. A. Ross, Frankfort, $50,050.

Indianapolis, Ind.—A bill has been passed in the State Legislature providing for the erection of an additional hospital for the insane, the appropriation being $560,000.

Auburn, Ind.—The Dekalb County Council, it is stated, has decided to erect a new county infirmary, and have $25,000 available.

Oskaloosa, Ia.—Frank E. Wetherell, of Oskaloosa, has been engaged to prepare plans and specifications for the new city hall, which is to cost about $40,000.

**Ft. Des Moines, Ia.*—Contracts have been awarded as follows for construction proper, on bids opened at this post on Jan. 19, by Capt. L. Hardeman, Q. M., U. S. A.: To N. P. Fransen & Co., 761 Wabash St., St. Paul, Minn., for 2 double sets Capts.' Qrs., $34,160; 2 double sets Lieuts.' Qrs., $24,580, and 2 double cavalry barracks, $88,200. To W. J. Zitterell, Webster City, Ia., for 1 Field Officer's Qrs., $10,803; 1 wagon shed, $2,166, and addition to Q. M. storehouse, $7,805. To C. E. Atkinson, Webster City, Ia., for 4 cavalry stables, including concrete piling under two of them, $63,844, and to Chas. Weitz Sons, 716 Mulberry St., Des Moines, for 1 double set civilian employes' qrs., $5,168, and 2 double sets cavalry stable gd. and shops, $7,716.

Des Moines, Ia.—Bids will be received Feb. 28 by the Bd. Co. Supervs. for the following work in connection with erecting court house: Carpenter and marble work, tile and cement floors, ornamental iron work, electric wiring, elevators, etc. Proudfoot & Bird, Archts., 712 Crocker Bldg.; Lew Burnett, Co. Aud.

Bids will be received until Mar. 14 by the Co. Bd. Superv. for $100,000 court-house bonds.

New Orleans, La.—Plans have been completed by Favrot & Livaudais, 839 Gravier St., for the Touro Infirmary, which is to consist of 3 wings, each 3 stories high, of brick, stone and terra cotta.

Plaquemine, La.—The Police Jury has decided to erect a court house, at a cost of $35,000.

Baltimore, Md.—The Bd. of Pub. Improv. on Feb. 11 endorsed the ordinances appropriating $25,000 for the purchase of a site and the erection of a truck house in the vicinity of Pratt and Calhoun Sts., and $13,840 for the erection and equipment of No. 13 Hook and Ladder Co.

Oakland, Md.—Holmboe & Lafferty, of Clarksburg, W. Va., it is reported, have been engaged by the Co. Comrs. to prepare plans for the $40,000 jail which is to be erected here.

Worcester, Mass.—The committee on Public Health is stated to have recommended an appropriation of $20,000 for an addition to the Isolation Hospital.

Brockton, Mass.—The Bd. of Aldermen has passed an order authorizing the erection of an armory, at a cost of $30,000.

Jackson, Miss.—P. W. Millsaps, Chmn. Bldg. Com., Mississippi Methodist Orphanage, writes that contract will be let about Mar. 1 for the erection of an orphanage, to cost about $25,000.

Natchez, Miss.—The following are the bids opened on Feb. 9 by the Superv. Archt., Treas. Dept., Washington, D. C., for the construction complete of the U. S. Post Office at Natchez: Stephenson & Getaz, Knoxville, Tenn., $34,500; F. L. Stevenson Contr. Co., Dallas, Tex., $35,900; Mankin Constr. Co., Richmond, Va., $34,164; Miles & Bradt, Atlanta, Ga., $43,000, and Athens Constr. Co., Athens, Ga., $35,783.

Herman, Mo.—The Gasconade County Court House, it is reported, has been destroyed by fire.

Jefferson Barracks, Mo.—Bids are wanted Mar. 10 for constructing a brick bakery and addition to guard-house; also frame coal-shed and addition to wagon-shed here. Maj. Thos. Cruse, Depot Q. M., St. Louis.

Dover, N. H.—A bill is now before the Legislature providing for the erection of a $25,000 armory.

Trenton, N. J.—The Bd. of Freeholders are reported to be considering the erection of a jail, at a cost of $100,000.

Belleville, N. J.—C. G. Jones, of Belleville, it is reported, has submitted plans to the Library Trus. for the brick, stone and terra cotta library. Andrew Carnegie has given $10,000 toward the cost.

Flushing, L. I., N. Y.—The following bids are reported to have been received Feb. 7, for erecting an armory: Morris Kantrowitz, Albany, $62,777; Jas. McArthur, Brooklyn, $85,167; Peter Keeler Co., Albany, $70,784; George Hildebrand, New York, $93,000; Hudson Valley Constr. Co., Troy, $62,000.

Albany, N. Y.—H. H. Bender, Fiscal Superv. of State Charities, in his annual report to the Legislature, recommends a special appropriation of $517,000 for new buildings and improvements, to include the enlargement of the dormitories at the Rome State Custodial Asylum and the New York State Custodial Asylum, at Newark, and the enlarging of the institutions at Sonyea, Albion and Bedford.

Ft. Wood, N. Y. H., N. Y.—Lieut.-Col. Geo. Ruhlen, of Washington, D. C., Deputy Q. M. Gen., U. S. A., writes that all bids opened on Jan. 20 for constructing 2 double sets officers' quarters, one double set non-com. staff officers' quarters, and one storehouse, all of brick, at Ft. Wood, Bedloe's Island, have been rejected, and new bids were to have been received and opened Feb. 14.

Plattsburg Barracks, N. Y.—Capt. T. B. Lamoreaux, Q. M., U. S. A., Burlington, Vt., writes that the following are the bids opened on Feb. 9 for constructing, etc., a band barrack at this post—*a*, construction; *b*, plumbing; *c*, heating; *d*, electric wiring: Alfred Pennington, Plattsburg, *a*, $16,466; *b*, $2-157; *c*, $1,650. Angus McDonald, Boston, Mass., *a*, $19,454. Arthur McQuillan, Plattsburg, *a* and *b*, total, $17,950; *c*, $1,461; *d*, $417. G. S. Blodgett Co., Burlington, Vt., *b*, $1,735; *c*, $1,235. Walworth Constr. & Supply Co., Boston, Mass., *c*, $1,427. Edw. P. Bates, Albany, *c*, $1,480. John W. Danforth Co., Buffalo, *c*, $1,550. Northern Electric Co., Burlington, Vt., *d*, $281. Buckley Constr. Co., Plattsburg, *a*, $17,401; *b*, $1,967; *c*, $1,405; *d*, $475.

New Paltz, N. Y.—Bids will be received Feb. 21 by Archibald McLaughlin, Co. Treas., at Kingston for $30,000 bonds to be used for rebuilding, altering and repairing county poorhouse here.

New York, N. Y.—The Assembly has passed a bill providing for an addition to be erected to the Metropolitan Museum of Art in Central Park.

The Bd. of Estimate has approved an appropriation of $213,000 for a power-house, morgue and laundry for the new Harlem Hospital.

Plans have been filed for erecting a 1-story brick and stone boiler-house at Blackwell's Island, opposite 52d St., for the city of New York, to cost $50,000. Wm. Flanagan, Archt., Foot of E. 26th St.

Bids will be received Feb. 24, by John F. Ahearn, Pres. Boro. Manhattan, for metallic and wood furnishings, electric work, etc., required in rooms assigned to Dept. of Finance, in basement of Hall of Records Bldg.

Rochester, N. Y.—Bids will be received by the State Bd. of Armory Comrs. at Albany, on Mar. 21, for the construction, structural steel, heating, plumbing, electric-light wiring and fixtures and gas piping, for a State armory at Rochester, as advertised in The Engineering Record.

Central Islip, N. Y.—Bids will be received by the State Comn. in Lunacy, at Albany, on Mar. 8, for erecting a dining room and Employes' Building, including heating, plumbing, electric light wiring and fixtures, at Manhattan State Hospital, Central Islip, as advertised in The Engineering Record.

Syracuse, N. Y.—The Bd. of Trus. of the Syracuse Homeopathic Hospital has engaged Albert L. Brockway, of Brockway & Taylor, O. C. S. Bk. Bldg., to prepare plans for the new wing to be erected at the hospital. The Trus. have about $50,000 available for the building, but this sum may not be used.

Ft. Caswell, N. C.—Bids will be received until Mar. 17 by R. H. Williams, Quarter-Master, for constructing a wagon-shed here, as advertised in The Engineering Record.

Grand Forks, N. D.—The Co. Comrs. have adopted plans and specifications submitted by Co. Surv. Lawson for remodeling the county jail, and the Auditor, it is reported, has been authorized to receive bids until Mar. 14 for making said improvements. Probable cost, $10,000.

Hillsboro, N. D.—Peter Davidson, County Aud., writes that the plans of Buechner & Orth, Manhattan Bldg., St. Paul, Minn., have been accepted for a court house for Traill County.

Fremont, O.—Reports state that bids will be received Feb. 22 by L. A. Dickinson, for $17,000 city hall bonds.

Eaton, O.—Plans are being prepared for improvements to be made to the court house, at a cost of about $50,000.

Newburg Heights, O.—Bids will be received Mar. 11 by P. S. Ruggles, Village Clk., Harvard and Independence Sts., for erecting a public hall and police station on Marcelline Ave. Fred. Baird, Archt., American Trust Bldg., Cleveland.

**Cincinnati, O.*—Contracts for erecting a 2-story brick engine house at Spring Grove and Alfred St. (bids opened Feb. 10) have been awarded as follows: For all work except iron work, to Wm. Miller & Son, of Cincinnati, for $18,875, and for the iron work to the Walton Iron Co., of Cincinnati, for $4,641.

Bids will be received Feb. 27 by the Bd. Pub. Safety for erecting a 2-story brick engine-house, with loft, at 7th and Sycamore Sts. Work to include excavation and masonry, brick, cut stone, cement and sheet metal work, plumbing and gas-fitting, electric wiring, etc. Clifford F. Lakeman, Secy.

Bids will be received until Mar. 8 by W. T. Perkins, City Aud., for $250,000 New Hospital Fund bonds.

*The contract to erect a guard house at Ft. Thomas, it is stated, has been secured by Edw. Bushnell, of Chicago, Ill., at about $20,000.

Chillicothe, O.—The following are the 3 lowest bids opened on Feb. 15 by the Superv. Archt., Treas. Dept., Washington, D. C., for a low-pressure steam-heating apparatus for the U. S. Post Office at Chillicothe: Henry Niemes, Cincinnati, $2,716; E. J. McDonough, Chicago, Ill., $2,890, and Graham & Jardine, Chillicothe, $2,923.

Norwood, O.—Bids will be received until Mar. 13 by W. E. Wichgar, City Aud., of Norwood, at the office of J. A. Stewart, Rm. 813, Traction Bldg., 5th and Walnut Sts., Cincinnati, for $10,000 bonds, issued for the purpose of improving, equipping and furnishing the building for the Fire Dept. and Police Station.

Medina, O.—A library is to be erected, at a cost of $10,000.

Shawnee, Okla. Ter.—A city hall is to be erected here, at a cost of $30,000.

Beaver Dam, Pa.—The local company of the National Guard, it is stated, will erect an armory here in the spring, at a cost of $25,000.

Pittsburg, Pa.—The Bd. of Trus. of the Homeopathic Hospital, it is stated, have selected a site at Center and Aiken Aves., on which it is proposed erecting their new building.

Laredo, Tex.—See "Sewerage and Sewage Disposal."

Ft. Douglas, Utah.—Plans are being prepared for an extension to the post exchange and gymnasium, to cost $10,000.

**Ogden, Utah.*—Thos. Lovell, of Denton, Tex., has secured the contract for constructing a post office and court house at Ogden (bids opened Feb. 1), for $158,725.

Grundy, Va.—Reports state that bids will be received Apr. 15 by the Clk. Bd. Co. Supervs. for erecting a $35,000 court-house here. Frank P. Milburn, Archt., Columbia, S. C.

**Wheeling, W. Va.*—Richardson & Burgess, of Washington, D. C., have secured the contract for erecting a white granite custom house, court house and post office at Wheeling, for $259,815.

Baraboo, Wis.—John M. True, Chmn. Bldg. Com. for the Sauk County Court House, writes that bids will be received on Apr. 1 for the erection of the building, which will cost about $87,000. Archts., Ferry & Clas, of Milwaukee.

Toronto, Ont.—Bids will be received Feb. 21 by Thos. Urquhart (Mayor), Chmn. Bd. Control, for erecting an art gallery on Toronto Exhibition Grounds.

Panama.—Bids will be received Mar. 9 by the Isthmian Canal Comn., Washington, D. C. (J. G. Walker, Chmn.), for furnishing doors, sashes and blinds.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Birmingham, Ala.—The erection of a Masonic Temple, 4 stories high, of brick and stone, to cost, including ground and fittings, about $60,000, is under consideration.

Mobile, Ala.—The Battle House, it is reported, has been destroyed by fire.

San Diego, Cal.—Articles of incorporation have been filed by the Wyatt Theater Co., with a capital of $100,000, for the purpose of erecting and maintaining a theater in this city. H. C. Wyatt, of Los Angeles, is one of the directors of the company.

San Francisco, Cal.—The members of the Golden Gate Commandery, No. 16, Knights Templar, it is reported, have decided to erect an asylum on Sutter and Pierce Sts., to cost about $72,000.

Jacksonville, Fla.—The Shrine Bldg. Assoc. (Geo. L. Bahl. Pres.), it is reported, has secured a site at Main and Monroe Sts., and intends erecting an 8-story building, to cost between $75,000 and $100,000.

Statesboro, Ga.—It is reported that a 3-story brick hotel is to be erected in this city. The Com. on Plans consists of G. S. Johnston, J. W. Olliff, Gustave Jackael and Brooks Simmons.

Items marked thus give the names of parties awarded contracts.

Danville, Ill.—C. F. Schultz, it is stated, is having plans prepared for a 2-story brick and stone business building which he intends erecting at a cost of about $10,000.

Paris, Ill.—The officials of the Vandalia Line (F. T. Hatch, Supt. Peoria Div., Terre Haute, Ind.), it is reported, intend erecting a passenger and freight depot in this city, to cost $20,000.

Moline, Ill.—G. H. Chase, it is stated, will erect a 3-story building to be occupied by Fisk & Loosley Co. Estimated cost, $30,000.

Richmond, Ind.—J. M. Hutton & Co., Mfrs. of Undertakers' Supplies, write that it is proposed to erect an addition to its factory which, when complete, will be 205x40 ft., with two wings about 40x75 ft. The entire building will be 4 stories. Present power plant will be used.

Washington, Ind.—The Knights of Columbus, it is reported, are preparing to erect a $32,000 lodge hall at 4th and Main Sts.

Indianapolis, Ind.—The officials of the Atlas Engine Wks. are stated to have decided to erect an office building, to cost $50,000.

The Chicago & Eastern Illinois R. R. Co. (J. F. Hinckley, Ch. Engr., St. Louis, Mo.) is reported to have decided to expend about $1,000,000 on new freight-houses and a new passenger station.

Peru, Ind.—R. A. Edwards, it is reported, may be able to give information regarding the forming of a company for the purpose of erecting a $30,000 opera house here.

Lafayette, Ind.—It is stated that plans have been completed for a $50,000 Y. M. C. A. building, which is to be erected in the spring.

Sioux City, Ia.—G. W. Burkhead, Iowa Savings Bank Bldg., it is stated, has been commissioned to prepare plans for a 4-story and basement brick building to be erected on Nebraska and 3d Sts., for Orcutt Bros., at a cost of $18,000.

Sioux City, Ia.—All buildings burned in the fire on Dec. 23 are to be rebuilt this season. Plans are being prepared for most of them; probable cost of all buildings in said district is $750,000.

Des Moines, Ia.—Proudfoot & Bird, Crocker Bldg., is preparing plans for a 2-story brick, 50x132-ft. building, to be occupied by the Munger Laundry and erected on W. Grand Ave. and 11th St.; cost, $20,000.

Plans have been completed for a 3-story store and apartment house to be erected by C. W. Rogg at W. 12th and Grand Sts.

Colfax, Ia.—Hallett & Rawson, of Des Moines, it is reported, have prepared plans for a hotel to be erected here, at a cost of $15,000.

Louisville, Ky.—It is reported that Arthur E. Mueller has purchased a site at 347 5th St., and will erect a building, to cost $50,000.

New Orleans, La.—It is reported that D. Mercier, the clothier, is contemplating the erection of an office building opposite his store on Dauphine and Bienville Sts.

Baltimore, Md.—Application has been made for a permit to erect the building for the Savings Bank of Baltimore, which is to be at Baltimore and Charles Sts., and is to cost about $275,000. John Hiltz & Sons, of Baltimore, are the builders; Parker & Thomas, of Baltimore, are the archts.

*Martin C. Miller, of Buffalo, N. Y., it is reported, has prepared plans for a 5-story warehouse which is to be erected at Howard and Franklin Sts., for the furniture and carpet house of John Turnbull, Jr., & Co. Fredk. Decker & Son, of Baltimore, are the builders.

**Muskegon, Mich.*—Miller & Bliss, it is reported, have received from the Mfrs.' Com. of the Chamber of Commerce the contract to erect the buildings here which are to be occupied by the Electric Fuse Co., of Adrian, the cost to be about $18,488.

St. Paul, Minn.—Plans have been filed, according to reports, for the 7-story brick building, 150x150, which is to be erected on E. 6th and Rosabel Sts. for the G. Somers Co. Cost, $200,000.

Minneapolis, Minn.—John Larkins, of Dubuque, Ia., it is stated, is the archt. for the proposed 4-story, 166x60-ft. reinforced concrete business building which is to be erected by the State Business College, of which G. A. Golder is Pres. Probable cost, $70,000.

Orange, N. J.—Edw. F. Flood, of Newark, and Fredk. R. Romer, of Orange, it is stated, intend erecting at Main and Park Sts., on the site of the Park Hotel, a 4-story brick and stone hotel, to cost about $125,000.

Deal Beach, N. J.—See "Sewerage and Sewage Disposal."

**Trenton, N. J.*—Lewis Lawton & Son, 432 Hamilton Ave., it is reported, have received the contract to erect a 3-story brick and iron building in the rear of the Mansion House, to be used for billiard rooms and bowling alleys, the cost to be about $30,000.

New York, N. Y.—The officials of the Chemical National Bank are said to be contemplating the erection of a new building, either 3 or 4 stories high, at the present site, Chambers St. and Bway.

Brooklyn, N. Y.—Saml. Koch & Sons, milliners, of Fulton St. and Elm Pl., it is reported, have secured a 21-year lease of the property at Fulton St. and Elm Pl., and intend erecting a 7-story granite and steel building.

Saratoga Springs, N. Y.—It is reported that the officials of the Delaware & Hudson and the New York Central & Hudson River Railroads, have agreed to contribute $250,000 toward the construction of a casino here if the village raise $75,000.

Utica, N. Y.—Improvements are to be made, according to reports, to the Dudley House, at a cost of $15,000. C. Y. Fuller, owner.

Oneida, N. Y.—It is reported that the owners of the Monroe Opera House have decided to make improvements, at a cost of $30,000. Address Mgr. Preston.

Syracuse, N. Y.—See "Railroads."

East Liverpool, O.—It is reported that the Order of Elks intends erecting a building, to cost $50,000.,

W. A. Calhoun, it is reported, is preparing plans for a 3-story reinforced concrete storage and amusement building, to be erected on W. Market St. by the United Warehouse Co., at a cost of $40,000. Geo. B. Thompson is reported interested.

Tiffin, O.—The heirs of the late Warren P. Noble, it is stated, will erect a $20,000 ground floor theater.

Springfield, O.—Bids will be received Mar. 6 at the office of C. H. Lyman, Grand Secy. I. O. O. F., Columbus, for furnishing material and erecting a brick annex to I. O. O. F. home here. Chas. E. Dawley & Bro., Superv. Archt., Bushnell Bldg.

Lorain, O.—It is reported that the Baltimore & Ohio R. R. shops have been destroyed by fire. D. D. Carothers, Ch. Engr., Baltimore, Md.

Columbus, O.—David Riebel, Eberly Bldg., it is reported, is preparing plans for a 4-story business building to be erected by Louis Fink at Front St. and Lynn Alley, at a cost of $15,000.

Cleveland, O.—The Lake Shore & Michigan Southern Ry. Co. (E. A. Handy, Ch. Engr., Cleveland) has applied for a permit to erect a 1-story addition to its building at Seneca and St. Clair Sts., to cost $25,000.

J. Milton Dyer, Cuyahoga Bldg., it is stated, is preparing plans for a department store and an arcade which Wm. Taylor, Son & Co., contemplate erecting on Euclid Ave.

It is reported that P. C. O'Brien, of the P. C. O'Brien Co., has secured a 99 year lease on the W. K. Corlett property on Prospect St., and it is stated, has announced that a building at least 4 stories high, to cost about $60,000, is to be erected on the site.

York, Pa.—It is reported that the Merchants Hotel is to be enlarged at a cost of $25,000.

Pittsburg, Pa.—Edw. F. Jackman, it is stated, is having plans prepared for an 8-story, 45x135-ft. warehouse to be erected at Penn Ave. and 3d St.

The Masonic Country Club members (Geo. Moore, of Bradock, Pres.), it is reported, have decided to organize the Masonic Land Co., with a capital of $100,000, and erect a club house to cost about $35,000.

**Philadelphia, Pa.*—A building permit has been granted to Armstrong & Latta, to erect for Frank M. Bostwick a 2-story laundry building, 53x125 ft., at 319 N. 32d St., to cost about $15,000.

Uniontown, Pa.—A. P. Cooper, of Uniontown, it is reported, has prepared plans for a $30,000 hotel to be erected by W. H. Lippincott, of Waynesburg.

**Chattanooga, Tenn.*—Adams & Sneider, 120 E. 8th St., it is reported, have received the contract to erect the 5-story brick and stone building on Boyce St. for Triggs-Dobbs & Co., at about $25,000. The contracts for the plumbing and electric fixtures are still to be let. Bearden & Foreman, are the archts.

Nashville, Tenn.—The Castner-Knott Dry Goods Co., it is stated, will erect a 6-story building on Church St., to cost about $200,000. C. B. Castner, Vice-Pres.

Humboldt, Tenn.—The Odd Fellows are said to be considering plans for a 3-story store and office building and lodge hall to be erected on Main St.

Knoxville, Tenn.—The Masons of the city are considering the erection of a temple, and have applied for a charter, the capital being placed at $100,000.

Memphis, Tenn.—It is reported that a 10-story building, 63x230 ft., will be erected by J. N. Oliver to replace building destroyed by fire some months ago. Alsup & Wood, Archts., Randolph Bldg.

**Beaumont, Tex.*—J. Frank Keith, it is reported, has awarded to W. C. Whitney the contract to erect a 2-story and basement brick addition to the Keith Bldg. on Pearl St., the cost to be about $20,000.

Dallas, Tex.—The Bldg. Com. of the Modern Order of Praetorians, it is stated, is considering plans for a 6-story fireproof building which is to be erected on Stone and Main Sts., at a cost of $85,000.

Salt Lake City, Utah.—Plans are stated to have been prepared for a $15,000 warehouse to be erected here by J. M. Wilfley.

Business blocks of brick will be built in the spring by Brigham Young Trust Co., as follows: On 1st, South and State Sts., 3-story, to cost $18,000; architect, C. M. Neuhausen, 528 Dooly Blk.; on Commercial Ave., 2-story, to cost $25,000; architect, D. C. Young, and West Temple St., 3-story, to cost $30,000; architect, D. C. Young.

Aberdeen, Wash.—R. J. Hiltz, it is reported, is promoting the scheme to erect a theater at Heron and G Sts., at a cost of $40,000. Many business men are reported interested in the project, including Wheeler Bros., W. B. Mack, and others.

**Wheeling, W. Va.*—Caldwell & Drake, of Columbus, Ind., it is reported, have received the contract to erect the Schmulbach building on Market St. The total cost of the building, it is reported, is to be about $425,000.

Fond du Lac, Wis.—The Masons are about to incorporate a company for the purpose of erecting a temple, at a cost of $25,000.

Milwaukee, Wis.—Dr. F. C. Studley, it is reported, is to be head of a sanitarium which is to be erected in the upper 18th Ward, in the vicinity of Milwaukee-Downer College. Leiser & Holst, Germania Bldg., it is stated, have prepared plans for the building, which provide for a 3-story and basement 64x102-ft. brick and stone structure to cost about $22,000. Work to begin in the early spring.

Winnipeg, Man.—A. Melville, it is reported, has prepared plans for improvements to be made to the Brunswick Hotel, at a cost of about $35,000. Wright & Carroll, owners.

New York, N. Y.

Southern Boule and Brook Ave, 5-story br factory; c, $45,000; o, Anton Larsen; a, Neville & Bagge.

5th Ave and 21st St, alterations to 11-story br and stone office and bank bldg; c, $20,000; o, Hudson Realty Co.

126 5th Ave, 15-story br and stone office store and storage bldg; c, $400,000; o, Fifth Ave and Eighteenth St Realty Co; a, Robt Maynicke.

236 E 28th St, 2 6-story br and stone stores and tenemts; c, $70,000; o, Hugo D Rosendorf; a, Horenburger & Straub.

99th St and Park Ave, 3 6-story br and stone stores and tenemts; total c, $108,000; o, Seider & Stoler; a, Edward A Meyers.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

Denver, Colo.—It is reported that plans have been submitted to Jas. O'Neill and other directors of the Actors' Home for a building which it is proposed erecting in the suburbs of Denver, at a cost of about $350,000.

Washington, D. C.—A building permit has been issued to the Kalorama Apartment House Co. to erect a 6-story fireproof apartment house at 1735 New Hampshire Ave., N. W.; cost, $150,000.

Cordele, Ga.—The congregation of the First Methodist Church, it is stated, intends erecting a new edifice, at a cost of about $20,000. The members of the Baptist Church are said to be contemplating the erection of a new edifice, to cost about $20,000.

Atlanta, Ga.—Plans prepared by H. Beckley, Empire Bldg., for the new Ponce de Leon Ave. Baptist Church have been accepted by the committee (Geo. M. Brown, Chmn.). The cost is reported to be about $38,000.

Peoria, Ill.—Henry Sandmeyer, Jr., it is reported, is preparing plans for an apartment house to be erected at Monroe and Fayette Sts., at a cost of $30,000.

Lincoln, Ill.—Geo. H. Helmle, of Springfield, it is stated, has completed plans for a $25,000 edifice to be erected for the Trinity Episcopal Church. Rev. Wm. N. Wyckoff, Pastor.

Ft. Wayne, Ind.—Reports state that the members of the Baptist Church have decided to improve the church at a cost of about $25,000. Rev. J. N. Field, Pastor.

Brazil, Ind.—The First Christian Church, it is reported, has been destroyed by fire.

Peru, Ind.—It is reported that bids will be received until Feb. 22 by the Bldg. Com. of the First Presbyterian Church for erecting a new edifice, not including plumbing and heating. W. V. Spinning, Trus.

Montezuma, Ia.—It is reported that the members of the M. E. Church have accepted the plans prepared by Frank E. Wetherell, of Oskaloosa, for their new edifice which is to be erected at a cost of $18,000.

Clyde, Kan.—It is reported that bids are wanted Mar. 15, for erecting a R. C. Church. Rev. J. J. Conway, Pastor.

Baltimore, Md.—Plans are being prepared by Edw. H. Glidden, of Baltimore, for a 7 or 8-story apartment house to be erected at Mt. Royal and Maryland Aves., at a cost of $150,000.

*Richd. H. Ford, it is reported, has received the contract to erect an edifice for the Union Baptist Church on Druid Hill Ave., to cost about $45,000.

Perham, Minn.—It is reported that the congregation of the St. Henry's R. C. Church contemplates erecting a new edifice, to cost $25,000. Rev. A. Schant, Pastor.

Albert Lea, Minn.—It is reported that the members of the Baptist Church contemplate erecting a new edifice, to cost $15,000. Address Pastor.

St. Louis, Mo.—Chas. H. Deitering, 708½ Pine St., it is reported, is preparing plans for a residence to be erected this spring on Lenox Pl., and to cost $16,000.

Moberly, Mo.—The members of the Baptist Church, it is stated, are preparing to erect a new edifice, at a cost of $20,000. J. M. Williams, Pastor.

Utica, N. Y.—The congregation of the Tabernacle Baptist Church, it is reported, intend making improvements to the edifice at a cost of $25,000. Rev. W. B. Wallace, Pastor.

Batavia, N. Y.—It is reported that the late Mrs. Adelaide Richmond Kenny has bequeathed to the St. James P. E. Church $100,000, $60,000 of which is to be used to erect a new edifice as a memorial to her husband.

Fayetteville, N. C.—S. W. Foulk & Son, Greensboro, N. C., it is stated, have prepared plans for a brick edifice, 75x122 ft., to be erected for the First Baptist Church, at a cost of $18,000.

Devil's Lake, N. D.—Anton Dohmen, of Milwaukee, Wis., it is stated, has prepared plans for a R. C. Church to be erected here, at a cost of $15,000. Rev. A. Henn, Pastor.

Massillon, O.—It is reported that the members of the Presbyterian Church intend erecting a new edifice at a cost of $40,000.

Portsmouth, O.—Plans will be received until Mar. 6 by Geo. E. Kricker, Central Savings Bank, Portsmouth, for the superstructure of a Catholic Church, with transept, to seat 700 persons, brick with stone trimmings, brick foundation, slate roof, and plastered walls, to cost $35,000 to $40,000 with unfinished towers; plans to include steam heat, electric and gas lighting, ventilating, organ loft and plain windows. Lot, 85x350 ft.

Ironton, O.—A. B. Alger & Son, Portsmouth, it is stated, have prepared plans for a $25,000 residence to be erected for Oscar Richey.

Cincinnati, O.—A permit has been issued to John C. Wagner to erect a 4-story flat on Maple St. and Reading Road, at a cost of $25,000.

Portland, Ore.—It is reported that the members of the St. Francis R. C. Church intend erecting an edifice, at a cost of about $50,000.

Shamokin, Pa.—Bids will be received Mar. 1, by the Bd. of Trustees (Rev. Father J. C. Konstankiewicz, Pres.) for erecting stone or brick Ruthenian Catholic Church of the Transfiguration here, to cost at least $35,000.

**Harrisburg, Pa.*—Danl. Knisley, it is reported, has received the contract to erect an edifice for the Second Reformed Church, at a cost of about $27,000.

**Philadelphia, Pa.*—John McShain, 631 N. 17th St., it is reported, has received a permit to erect a 1-story stone edifice at Warren and Media Sts. for the St. Gregory R. C. Church, at a cost of $54,000. Rowland W. Boyle, Archt., 1530 Chestnut St.

*F. H. Havens & Co., it is stated, has received the contract to erect an apartment house in Mt. Airy for Laura J. Watson, to cost $26,000.

Ft. Wayne, Tex.—It is reported that the congregation of the First Methodist Church intends erecting a new edifice, at a cost of $30,000. Rev. Alonzo Monk, Pastor.

Roanoke, Va.—The Second Presbyterian Church congregation, it is reported, intends erecting an edifice at a cost of $17,000.

**Athens, Wis.*—M. Snyder, of Arcadia, it is stated, has received the contract to erect a $20,000 edifice for the R. C. Church.

Janesville, Wis.—The members of the Central Methodist Church intend erecting an edifice, to cost $30,000.

Milwaukee, Wis.—Henry Nunnemacher, it is reported, intends erecting an apartment house on Lake Ave. and Folson Pl., to be 4 stories high and cost about $100,000.

Horicon, Wis.—It is reported that Van Ryn & De Gelleke, 211 Grand Ave., Milwaukee, have prepared plans for a residence to be erected here for S. N. Campbell, at a cost of $14,000.

New York, N. Y.

Sheriff and Rivington Sts, 6-story br and stone tenemt; c, $45,000; o, Louis Reiner; a, Bernstein & Bernstein.

108th St and 2d Ave, 6-story br and stone tenemts; total c, $350,000; o, Israel Lippman; a, Bernstein & Bernstein.

Park Ave and 103d St, 3 6-story br and stone tenemts; total c, $104,000; o, Chas Weinstein; a, Geo F Pelham.

2d Ave and 119th St, 6-story br and stone tenemt; c, $40,000; o, David Herman; a, Sass & Smallheiser.

136th St and Bway, 5-story br and stone tenemt; c, $75,000; o, Simon Marcus; a, Moore & Landsiedel.

136th St and Bway, 3 5-story br and stone tenemts; total c, $225,000; o, Geo Brown; a, Moore & Landsiedel.

Bway and 136th St, 2 5-story br and ston tenemts; total c, $150,000; o, Transit Realt Co; a, Moore & Landsiedel.

148th St and 8th Ave, 3 5-story br an stone tenemts; total c, $126,000; o, Walthe & Weitzer; a, Geo F Pelham.

8th Ave and 14th St, 5-story br and ston tenemts; c, $42,000; o, Louis I Bablove; Geo F Pelham.

165th St and Amsterdam Ave, 5-story and stone tenemt; c, $40,000; o, Joh Rankin; a, Moore & Landsiedel.

Dawson St and Longwood Ave, 7 5-sto br tenemts; total c, $350,000; o, Park Co struction Co.; a, Moore & Landsiedel.

Hewitt Pl and Longwood Ave, 5-story tenemt; c, $40,000; o, Longwood Realty C a, John E Scharsmith.

147th St and St Ann's Ave, 5-story tenemt; c, $45,000; o, John Brown; a, Sa & Smallheiser.

166th St and Union Ave, 3 5-story tenemts; total c, $114,000; o, Wm Eise hauer; a, Adolph Mertin.

Prospect Ave and Dawson St, 4-story tenemt; c, $25,000; o, Geo Brown; a, Moo & Landsiedel.

St. Ann's Ave and 137th St, 3 6-story tenemts; total c, $130,000; o, Western Real Co; a, Geo F Pelham.

SCHOOLS.

Notes Arranged Alphabetically by States.

Bisbee, Ariz.—It is stated that the Scho Bd. has under consideration the issue of $5 000 Central High School Bonds.

South Norwalk, Conn.—At a meeting the School Dist. on Feb. 7 it was voted appropriate $40,000 for the erection of 8-room school at Chestnut and Concord St

Storrs, Conn.—Bids will be received F 28 by Jas. F. Walsh, State Treas., at Ha ford for erecting, including heating, plum ing, electric work, and furnishing a brick d mitory for Conn. Agricultural College her

Decatur, Ga.—It is reported that an ann is to be erected to the Agnes Scott Insti tion, which will cost about $60,000. S. Inman, of Atlanta, is Chmn. of the Bd. Trus.

**Items marked thus give the names of parties awarded contracts.*

At s, Ga.—The Bldg. Com. of the State orm School (R. E. Davison, Chmn.), it is po i, has decided to have the archts. of e te submit plans by Mar. 9 for the new il to be erected at the State Normal ho

P a, Ill.—Reeves & Baillie, Y. M. C. A. ldg it is stated, is preparing plans for 2 ho , one to be an addition to the High ho of brick, 3 stories high, to cost $45,- 00 ne other a 2-story brick ward school, $30,000.

B ington, Ill.—Reports state that bids ill received Mar. 1 by John C. Plagge for ec g a brick school. Turnbull & Jones, rc , Elgin.

C ago, Ill.—Dean Wm. B. Owen, of the ig School, it is reported, has announced a ew buildings, to cost $1,000,000, are erected at the Univ. of Chicago. The il gs will include a museum, recitation il g, lecture hall, gymnasium and theater.

V Buren, Ind.—The Township Trus., it r rted, have decided to erect a high school r e joint use of the town and township, e st to be $20,000.

Moines, Ia.—The School Bd. is about horize the issue of $40,000 bonds for e ection of a school at 12th and College ts subject to the vote of the people on ar 7.

O watomie, Kan.—It is stated that the cit- e have voted to issue $17,000 bonds to e a new school.

thiana, Ky.—The Bd. of Educ., it is a ., has accepted the plans submitted by h C. Weber, of Cincinnati, O., for the e school which is to be erected at a cost 5,000. The plans provide for a 3-story r ure having 15 rooms.

no, Me.—Pres. Geo. E. Fellows, of the n of Maine, it is stated, has announced a Andrew Carnegie has given $50,000 to e niv. to erect a library. Plans are to be immediately.

timore, Md.—The following are report- be the bids received Feb. 8 by the Bd. wards for erecting the Eastern High l at Bway. and North Aves.: Thomas , Philadelphia, Pa., $295,000, 18 hs; Cramp & Co., $313,950, 20 months; . & G. H. Thomas, $319,000, 16 months; es McCaul Co., $319,804, 17 months; erson & Co., $332,770, 15 months; Hen- mith & Son Co., $333,758, 18 months; Steel & Son, $339,697, 12 months; Chas. ockhausen, $341,737, 23 months; Brod- & Wind, $344,395, 18 months; Noel r. Co., $346,500, 18 months; Thompson- rett Co., $348,700, 7 months; Murphy tr. Co., $356,779, 365 working days; Bros. Co., $357,913, December 31, 1905. ers of Baltimore, unless otherwise stated.

well, Mass.—It is reported that local s. have been requested to submit plans eb. 27 for an 8-room school to be erected entralville, the cost not to exceed $60,-

oucester, Mass.—A loan of $40,000 is emplated by the City Council to cover of purchasing land and erecting an 8- school in Ward 2.

verly, Mass.—See "Water."

orcester, Mass.—The City Council is re- ed to have under consideration the erec- of a $150,000 addition to the Classical School.

olyoke, Mass.—The School Com. (Jas. J. nnell, Chmn.) has asked for an appro- tion of $65,000 for the purpose of erect- a 16-room school on Sargeant St. No s have been drawn as yet.

oston, Mass.—Bids will be received Feb. y the Schoolhouse Comrs., of Boston, for alling ventilating and heating system, ary school, Blue Hill Ave., McLellan and way Sts., Dorchester. Jas. E. McLaugh- Archt., 683 Atlantic Ave.; R. Clipston rgis, Chmn.

aginaw, Mich.—C. L. Cowles, Chase Blk., reparing plans for rebuilding the Hough- School, recently burned; probable cost of building, $15,000.

nn Arbor, Mich.—Clare Allen, of Jackson, stated, has been engaged to prepare plans the high school.

ockland, Mich.—Myers & Thielman, of rium, it is stated, submitted the lowest for erecting a school on Cedar St., at ,940.

t. Pleasant, Mich.—C. L. Cowles, of Sagi- v, it is stated, is preparing plans for a ,000 school to be erected by the R. C. rch. Rev. O'Connor, Pastor.

ong Prairie, Minn.—A parochial school is be erected here this spring, at a cost of ,000.

Halsted, Minn.—H. P. Nygaard, Secy. ool Bd., writes that the contract for erect- a high school (bids opened Feb. 8) has n awarded to Olson & Skoolheim, of Wil- r, for $14,280.

Hattiesburg, Miss.—A 7-room brick school to be erected in the 3d Ward with the $16,- bonds recently issued.

*St. Louis, Mo.—A building permit has been nted to Gillick Bros., 7925 Minnesota Ave., erect the Shepard School on 3450 Wiscon- Ave. It is to be a 3-story fireproof struc- e, 246x121 ft., and to cost $129,975.

Hoboken, N. J.—The Bd. of Educ. is con- nplating the erection of a school in the inity of 3d St.

Metuchen, N. J.—A com. of the Bd. of uc. has recommended the erection of a new ool, at a cost of $40,000.

Jicarilla, N. M.—Bids will be received Mar. y the Comr. Indian Affairs, Dept. Interior has. F. Larrabee, Acting Comr.), Washing- , D. C., for furnishing material and con- ucting a hospital at the Jicarillo School. H. Johnson, of Dulce, is Supt.

Ogdensburg, N. Y.—It is reported that $40,000 bonds are to be issued for school buildings.

**Brooklyn, N. Y.*—The following are the bids opened on Feb. 14, by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for general construction of School No. 66, Brooklyn Boro.: Clarke & Stowe, 15th Ave. & 71st St., $307,700 (awarded contract); Thos. Cockerill & Son, $364,500; P. J. Brennan, $330,000 K. A. Murphy, $368,000; Richard E. Heningham, $319,800; Geo. Hildebrand, $319,600; John Auer & Sons, $326,600; John Thatcher & Son, $345,000; Juan B. Arci, $322,000; Chas. H. Peckworth, $319,430; Guidone & Galardi, $335,000; Wm. Werner, $329,480, Buckley Realty Constr. Co., $316,500. Wm. C. Ormond, 14 Herbert St., secured the contract for the plumbing and drainage of same at $3,287.

*The following are the bids opened same time and place for sanitary work and gas fitting of School No. 147, Brooklyn Boro.: Jere. J. Deady, $37,991; Jas. Fay's Son, $34,887; Wm. C. Ormond, 14 Herbert St., $33,700 (awarded contract); Chris. Nally, $36,810, and Jas. Harley, $37,881.

Troy, N. Y.—J. J. Albright, of Buffalo, has given $50,000 to the Rensselaer Polytechnic Institute toward the erection of a chemical laboratory.

New York, N. Y.—The Bd. of Estimate has approved an appropriation of $3,500,000 for the Bd. of Educ. for school buildings and sites.

Bids will be received Feb. 27 by C. B. J. Snyder, Supt. of School Bldgs., for erecting 3 outside iron stairs at School No. 23.

C. B. J. Snyder, Supt. of School Bldgs., it is reported, has been directed by the Bldg. Com. of the Bd. of Educ. to prepare plans for a fireproof building, having a seating capacity of at least 2,500, to take the place of the school at Grove and Hudson Sts., which was destroyed by fire on Feb. 14.

Bolivar, N. Y.—The following are reported to be the bids received by the Bd. of Educ., for erecting the brick high school: Oak Duke Lumber Co., Wellsville, $36,248; B. N. Taylor, Olean, $29,268; W. C. Oswald, Hornellsville, $27,941; L. C. Rudolph, East Aurora, N. Y., $25,161; Werdein & Rail, Dansville, $21,363.

Castleton, S. I., N. Y.—Bids will be received Feb. 27 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for erecting School No. 16, Boro. Richmond.

**Mariner Harbor, S. I., N. Y.*—The following are the bids opened on Feb. 14 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for general construction of additions to and alterations in P. S. 23, Mariner Harbor, Richmond Boro.: Hartman & Horgan, $64,887; Ph. Wolff & Son, $62,833; Jas. MacArthur, $67,993; Jos. Ohlhausen, $62,384; Chas. H. Peckworth, $62,940; Thos. Cockerill & Son, $72,771; Conrad Hewitt, Inc., 1123 B'way, N. Y. City, $62,150 (awarded contract); Louis Wechsler, $69,600, and Osborn & Bailey, $71,730.

**Charlotte, N. C.*—J. E. Jones, it is reported, has received the contract to erect the O'Donohue School Home on the St. Mary's Seminary site, at about $20,000. It is to be a 3-story brick and stone structure.

Arthur, N. D.—It is reported that bids will be received Feb. 24, by S. Brandenburg, Clk., for erecting a school.

Niles, O.—W. H. Pritchard, Clk. Bd. Educ., writes that bids will be received on Mar. 1 for $40,000 school bonds, and on Mar. 8 for the erection of two 4-room schools and a 4-room addition to a school.

Granville, O.—It is reported that a $15,000 gymnasium is to be erected at Shephards Baptist College. Address President.

Milford Center, O.—It is reported that the High School has been destroyed by fire.

Cleveland, O.—Bids will be received until Mar. 13 by the Bd. of Educ. for furnishing material and erecting an annex to the Tod School. Bids on material and labor are to be furnished separately, and are to include mason, cut stone, carpenter and sheet metal work, iron and steel, cement floors and base, fireproofing, ventilating and heating, plumbing, sewers and gas-fitting, etc. Chas. Orr, Dir. of Schools.

Elyria, O.—Reports state that bids will be received Feb. 20 by C. H. Snow for $30,000 school bonds.

Van Wert, O.—It is reported that plans have been completed for a 10-room school, and that bids will be asked at once.

Tiffin, O.—It is stated that plans are being prepared for a ladies' dormitory to be erected during the coming season at the Heidelburg University. J. H. Platt, of Tiffin, Pres. Bd. of Regents.

**Philadelphia, Pa.*—A building permit has been granted to Lynch Bros., 46 N. 12th St., to erect a 3-story brick and stone school at Race and Farson Sts., to cost $83,500, and a 3-story brick and stone school at 51st St. and Willow Ave., to cost $62,700.

Local press reports state that John R. Wiggins & Co., Heed Bldg., submitted the lowest bid for erecting the school at 23d and Brown Sts., and a school at 38th St. and Powelton Ave., at a total of $187,000, and Thos. Reilly, 1616 Thompson St., the lowest bid for erecting a school at Rhawn and Ditt-man Sts., at $53,466.

Elkins Park, Pa.—Bids will be received until Mar. 4 by Brockie & Hastings, Archts., 328 Chestnut Sts., Philadelphia, Pa., for erecting the Cheltenham High School in Elkins Park. Bids are to include names of sub-contractors.

Ripon, Wis.—Plans for remodeling the West College of Ripon College, it is reported, have been adopted. Probable cost, $15,000.

Rice Lake, Wis.—It is reported that an ordinance has been passed providing for the issue of $32,000 bonds for the erection of a high school.

La Crosse, Wis.—The School Bd., it is reported, is in favor of the plans submitted by John C. Llewellyn, of Chicago, Ill., for the proposed high school, the cost to be about $120,000. Appropriation, $100,000.

Madison, Wis.—It is reported that the School Bd. has decided to enlarge the Northeast Dist. School, at a cost of $12,000.

Coyoacan, Mex.—John H. Converse, of Philadelphia, Pa., it is reported, has given to the Presbyterian Bd. of Foreign Missions of New York City, $50,000 for the Presbyterian College and theological seminary here. Of this amount $40,000 has been appropriated to the college and seminary with which to purchase lands and erect a dormitory and a general college building.

Toronto, Ont.—Bids will be received Feb. 24 by W. C. Wilkinson, Secy.-Treas. Bd. Educ., for erecting a school on Broadview Ave.

Montreal, Que.—It is reported that the Protestant Bd. of School Comrs. will expend $120,000 on school extensions.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Cleveland, O.—Bids will be received Mar. 1 by the Bd. Pub. Service for enlarging Cleveland garbage disposal plant at Willow, by erecting machinery for reduction of garbage, night soil, dead animals, etc., and erecting necessary buildings to contain same. A. R. Callow, Secy.

* *Darby, Pa.*—Bids are wanted Feb. 23, for collecting garbage for year 1905. Jas. Beith, Secy. Bd. Health.

Toronto, Ont.—John Jones, Street Comr., writes that the question of constructing an incinerator for the destruction of refuse is under consideration, but nothing definite has been decided upon as yet. But if built it will be done by day labor from plans prepared by the city officials.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

The C. J. Kindel Bedding Co., 209 N. Main St., St. Louis, Mo., has had plans drawn for a 3-story. 50x100-ft. building. Electric power of about 30 h.p. will be furnished by several motors, and the plant will be equipped with power elevator, sprinkler system, telephone system, etc.

The Tubbs Mfg. Co., South Windham, Conn., is building a 3-story, 50x200-ft. addition to its plant. The company is in the market for a 150-h.-p. Corliss engine, boilers, motors, freight elevator, shafting, hangers, etc.

The Deer Lick Mining & Development Co., Spearfish, S. Dak., will soon install some heavy machinery for hoisting purposes and handling water, and will also build a mill of 100 tons daily capacity the coming summer.

Phillips Bros., 625 Adams St., Springfield, Ill., expect to build a 2-story and basement, 40x160-ft. printing plant. The power required will be about 30 or 40 h.p.

Geo. T. Rather, Aberdeen, Miss., desires information regarding the cost of establishing a rope factory or cordage plant.

The cold-storage warehouse of the Schwarzschild & Sulzberger Co., Chicago, which was recently burned, will be rebuilt. No power plant will be required.

The Glanntown Stone & Glass Sand Co., 869, The Spitzer, Toledo, O., has been incirporated, with a capital of $150,000. The company will build a large double plant at Glanntown, one part of the plant to have a daily capacity of 1,600 tons crushed stone and the other part to have a capacity of 400 tons of glass sand. A railroad about 3 miles long will be built connecting with the Lake Shore road near Sylvania station. Walter C. Gayhart, Secy.

The Koepke Nut & Bolt Co., Elyria, O., contemplates enlarging its plant, but plans have not been completed.

The Sioux City, Ia., Foundry & Mfg. Co. is adding a molding room, 75 ft. square, to its plant, and will equip it with a three-motor traveling crane and a 54-in. cupola.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

**San Francisco, Cal.*—The following are reported to be the bids opened on Feb. 2 by the Harbor Comn. for the construction of Vallejo St. pier: Cotton Bros. & Co., $118,640; Healy, Tibbitts & Co., 22 Market St., $114,788 (awarded contract); City Street Improvement Co., $123,000; Atlantic, Gulf & Pacific Co., $117,480; Robt. Wakefield, $116,329; Hyde-Harges Co., $120,000; Thompson Bridge Co., $117,820; Pacific Constr. Co., $118,973, and S. D. Le Clair, $119,460.

Mrs. Honora Sharp is reported to have bequeathed $200,000 for the erection of a gateway to the Panhandle at the Golden Gate Park as a memorial to her husband.

Washington, D. C.—Bids will be received Mar. 14 at the Bureau Supplies and Accounts, Navy Dept., Washington, for furnishing at navy yards, Portsmouth, N. H.; New York, N. Y.; League Island, Pa.; Norfolk, Va.; Naval Academy, Annapolis, Md., and naval station, Guantanamo, Cuba, a quantity of machine tools, consisting of concrete mixer, hoisting engines, derricks, pile drivers, motor-drive outfit for pipe-threading machine, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

**Chicago, Ill.*—The Otis Elevator Co., of New York, N. Y., has secured the contract for mail chutes, etc., for the Chicago Post Office, for $26,400.

The Park Comrs. are stated to have adopted plans for the enlargement and improvement of Lincoln Park, at a cost of about $1,000,000.

Chicago, Ill.—The following are the bids opened on Feb. 4 for dredging and constructing docks in Chicago River; (*a*) The L. P. & J. A. Smith Co., Cleveland, O., total bid, $174,061; (*b*) Duluth Dredge & Dock Co., Duluth, Minn., $147,636; (*c*) Samuel O. Dixon, Milwaukee, Wis., $143,945; (*d*) Fitz-Simons & Connell Co., Chicago, Ill., $141,921; (*e*) Edw. Gillen, Racine, Wis., $144,580; (*f*) Buffalo Dredging Co., Buffalo, N. Y., $156,675; (*g*) Chicago & Great Lakes Dredge & Dock Co., Chicago, Ill., $126,704:

	a.	*b.*	*c.*	*d.*	*e.*	*f.*	*g.*
764,100 cu. yd. dredging	$0.18¾	$0.15	$0.14½	$0.14½	$0.14	$0.16	$0.12¾
Removal old lock wall (lump bid)	600.00	1,900	1,500	1,500	3,000	2,500	1,340
310 white oak piles 45-ft. long..	13.00	13.50	13.50	13.50	15.00	14.00	12.25
260 hardwood piles, 30-ft. long..	6.20	6.50	6.60	6.00	10.00	7.00	6.00
1,180 lin. ft. 32-ft. sheet piling,...	15.00	14.80	15.84	14.40	16.00	15.75	13.50
31.9 M. ft. oak caps and wales.	50.00	55.00	52.50	50.00	60.00	50.00	45.00
9.41 " oak stringers,4x12-in.	48.00	50.00	49.00	45.00	50.00	45.00	45.00
11.8 " pine logs, 10x12-in..	40.00	40.00	40.00	40.00	60.00	40.00	40.00
16,461" pine stringers.	40.00	40.00	37.00	40.00	60.00	40.00	37.50
14.12 " hemlock logs,12x12-in.	38.00	35.00	34.00	40.00	45.00	33.00	35.00
67.280 lbs. anchor rods, etc.....	.05	.06	.05¼	.05	.06	.05½	.05
1,300 " screw bolts, nuts, etc.	.05	.06	.05	.05	.06	.04	.05
6,500 " drift bolts	.03½	.04½	.03½	.04½	.05	.04	.04
480 " spikes and nails......	.03½	.04	.03½	.04	.06	.04	.03½

The O. H. Peck Co., 112-116 So. 5th St., Minneapolis, Minn., is putting up a 2-story and basement, 50x157-ft. building. Electric power will be used and a heating plant will be installed. Considerable wire glass will be required.

The Gibson-White Co., Dayton, Tenn., has been formed, and will move its plant to Chattanooga, where a foundry 60 ft. square, for manufacturing stoves and general jobbing work, will be built. Engine and boiler of about 30 h.p. will be required.

L. Harbach, Des Moines, Ia., has plans for a 6-story, 90x130-ft. warehouse, which will be devoted to mattress factory, office, stock and warerooms. The building will be heated by steam and equipped with freight elevator of 2 tons capacity, sprinkler system, fire doors, etc. When this building is completed, he will erect a 2-story, 44x132-ft. brick factory building for making furniture, which will be equipped with boilers, engines, dynamos, pumps, etc. This second building may not be erected for a year. H. F. Liebbe, Des Moines, archt.

J. L. Ballinger, Bellefontaine, O., will have charge of construction and engineering work and act as purchasing agent for the cement plant to be built at Lake Borgne, near New Orleans, La.

Hugh Sutherland, of Mackenzie, Mann & Co., Ltd., Toronto, Can., writes that plans have not yet been prepared for the new plant to be erected by the recently organized furnace company.

The Clarksdale, Miss., Machinery & Supply Mfg. Co. will erect a 2-story, 50x100-ft. brick building, and is in the market for building material and machine tools, such as lathes, planers, drills, etc.

The U. S. Brick Corporation, Michigan City, Ind., will erect a plant, about 80x160 ft. in size, for the manufacture of sand lime brick. A 150-h.-p. boiler and an engine of about 100-h.-p. capacity will be required.

**Harvel, Ill.*—Engr. J. W. Dappert, Lock Box 141, Taylorville, writes that the following are the bids opened on Jan. 28 for clearing out and re-excavating open ditches, requiring the removal of about 39,873 cu. yd. of earth (price given per cu. yd.): Gus. Wilson, Rosemond, 35 cts.; Demoulin & Hauptman, Harvel, 29.98 cts.; A. J. Klentschy, East Prairie, Mo., 30 cts., and Jos. Lewis, Atwood, 29.99 cts. (awarded contract).

La Salle, Ill.—It is stated that the possible improvement of the Illinois & Michigan canal basin at La Salle, to cost about $30,000, is to come from the present Legislature.

Brookville, Ind.—It is stated that the Comrs. of Franklin County will probably soon let contract for the construction of the Griffith ditch in Bath and Springfield townships; estimated cost, $8,613.

Peru, Ind.—The Comrs. of Miami County are reported to be preparing to let contracts for the construction of the Weaver and Kitchen ditch.

New Orleans, La.—See "Water."

New Orleans, La.—Bids will be received by the Bd. of Comrs. of the Port of New Orleans on Mar. 9 for the construction of the Henderson St. steel shed No. 2, as advertised in The Engineering Record.

Bids will be received Mar. 1, by the Bd. Comrs. of Port of New Orleans, Nos. 601-602 Hibernia Bank and Trust Co. Bldg., for $750,000 bonds to be used for the purpose of constructing wharves, sheds, roadways and other improvements necessary for shipping facilities in Port of New Orleans. W. A. Kernaghan, Secy.

Bids will be received until Mar. 25 by Mordecai T. Endicott, Ch. Bureau of Yards and Docks, Navy Dept., Washington, D. C., for constructing a steel and timber wharf at the Naval Station here. Funds available, $42,000. Plans may be secured from the Commandant at the Naval Station, New Orleans.

**Items marked thus give the names of parties awarded contracts.*

Detroit, Mich.—Bids are wanted Mar. 8 for hire of dredging plant for use in Lake St. Clair. Lieut.-Col. Chas. E. L. B. Davis, Corps Engrs., U. S. A.

Minneapolis, Minn.—It is stated that bids are wanted Feb. 24 for furnishing 20,000 bbl. natural cement and 17,500 bbl. Portland cement, to be used in sewer and paving construction during year 1905. Andrew Rinker, City Engr.

Macon, Mo.—It is stated that bids will be received Mar. 20 by W. G. Walker, for excavating drainage ditch about 9 miles long, 20 ft. wide at bottom, 10 ft. deep, requiring 389,000 cu. yd. excavation.

Omaha, Neb.—Bids are wanted Feb. 28 for installing electric elevators in quartermaster's new storehouse here. Lieut.-Col. J. E. Sawyer, Ch. Q. M.

Portsmouth, N. H.—Bids will be received Mar. 11 by Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C., for furnishing and installing 2 electric elevators at navy yard here.

Avon by the Sea, N. J.—Press reports state that bids will be received by the Boro. Council until Feb. 20 for constructing a boardwalk and general beach improvements.

New York, N. Y.—The following are the bids opened on Feb. 9 by the Dept. of Parks for furnishing labor and material for repairing and strengthening dyke along Cromwell's Creek water front of Macomb's Dam Park: J. M. Briggs, 17 Battery Pl., $11,354; Joseph Gallo, 127 Mulberry St., $13,809; Hugh Hart, 150 Pearsall St., L. I. City, $12,386; Geo. Humphreys, 575 Clinton St., Brooklyn, $10,886; Bernard Rolf, 39 Cortlandt St., $10,980; Seely-Taylor Co., 78 Broad St., $15,680, and Jno. D. Walsh, 397 Hancock St., Brooklyn, $11,039.

Catskill, N. Y.—Bids will be received by the West Shore Stone Co., at once, for hauling 100,000 yd. of stone from quarry to dock at Catskill, a distance of about 1¼ mile down-hill. Contractors to have a capacity for handling 400 yd. per day. Company to load and unload teams.

Troy, N. Y.—Bids will be received until Feb. 24 by the Bd. of Contract and Supply for furnishing to the Dept. of Pub. Wks. 26 dumping wagons. Jas. M. Riley, Clk.

**Brooklyn, N. Y.*—Geo. W. Spearin, of New York, recently awarded contract for the construction of a dry dock at the New York Navy Yard, at a cost of $773,292, has signed the contract, and work will probably be commenced at once.

Bids will be received Mar. 2 by F. M. Gibson, Deputy and Acting Comr. of Street Cleaning, N. Y. City, for furnishing and delivering iron.

Wilmington, N. C.—Bids will be received until Mar. 18 by Capt. R. P. Johnston, Corps Engrs., U. S. A., Wilmington, for stone and cement, as advertised in The Engineering Record.

Findlay, O.—There is reported to be a movement on foot for the construction of a waterway from a point in Hancock County through the counties of Wood and Lucas. Congress will be asked to appropriate $100,000, the State $50,000, and the taxpayers the remainder.

London, O.—Bids will be received Feb. 25 by the Bd. Co. Comrs. for $18,580 ditch improvement bonds. B. A. Taylor, Co. Aud.

Akron, O.—It is reported that $75,000 will soon be expended in improving the Ohio & Erie Canal between Akron & Cleveland, under direction of State Bd. of Pub. Works, at Columbus.

Portland, Ore.—Press reports state that the folowing are the bids opened on Jan. 31 for furnishing and delivering stone for jetty construction at mouth of Columbia River J. W. Sweeney, of Portland, to furnish 400,000 tons of stone at $1.02 per ton, f. o. b. barges at Ft. Stevens, the stone to be taken from the Bunker Hill quarry, near Stella, Wash. The Columbia Contract Co., Portland, submitted 2 bids, one for 450,000 tons of stone at $1.10, f. o. b. barges at Ft. Stevens, the stone to be quarried at Fisher's Landing, the other for not less than 200,000 tons at 62 cts., f. o. b. the cars at Butte quarry.

Philadelphia, Pa.—Bids will be received Feb. 20, by Fred. J. Shoyer, Dir. Dept. of Supplies, for furnishing 7,500 lengths of 6, 8, 10 and 12-in. pipe.

Bids will be received Mar. 6, by the Bd. Port Wardens, Rm. 350 and 351 Philadelphia Bourse, for dredging docks and in front of bulkheads not belonging to city. Geo. F. Sproule, Secy.

Harrisburg, Pa.—The State Senate is stated to have passed the bill appropriating $1,800,000 for the extension of a park surrounding the State Capitol.

Wheeling, W. Va.—Bids will be received by Maj. Geo. A. Zinn, U. S. A., Wheeling, on Mar. 14 for furnishing and delivering about 7,500 bbls. American Portland cement for Dam No. 13, Ohio River, as advertised in The Engineering Record.

Brandon, Man.—See "Sewerage and Sewage Disposal."

Winnipeg, Man.—Bids are wanted Feb. 28 for gondola hopper cars, as advertised in The Engineering Record.

Peterborough, Ont.—Bids will be received Mar. 15, by S. R. Armstrong, Town Clk., for furnishing about 3,500 bbl. Portland cement; bidders will state whether cement is packed in sacks or bbls., net weight per sack or bbl., and price f. o. b. Peterborough.

Panama.—The following are the bids opened Feb. 7 by the Isthmian Canal Comn., Washington, D. C., for (*a*) hand cars, push cars, rail cars, parts for repair of cars; (*b*) steam hammers; (*c*) engine lathes; (*d*) planers; (*e*) milling machines; (*f*) boring machines (bidders of New York, N. Y., unless otherwise mentioned): Maxwell, Moore & Co., *a*, $1,296; *b*, $2,475; *c*, $6,471; *d*, $4,263; *e*, $1,149; *f*, $1,339. Fox Bros. Co., *a*, $1,128; *b*, $1,963; *d*, $3,318; *e*, $1,250. J. J. McCabe, *d*, $3,900. Motley, Green & Co., *a*, $1,160. H. A. Rogers, *a*, $1,293; *b*, $2,250; *d*, $4,220. Montgomery & Co., *a*, $1,064. J. J. Shannon, *a*, $1,293; Fairbanks, Morse & Co., *a*, $953. Hardware Mfg. Co., *a*, $1,030; Buda Fdy. & Machine Co., *a*, $924. Roberts Car & Wheel Co., *a*, $883. Niles-Bement-Pond Co., *c*, $7,148; *d*, $3,368; *e*, $1,896; *f*, $1,500. Handlin & Burk Mfg. Co., *b*, $1,875. W. W. Clark & Sons, Baltimore, Md., *b*, $2,595. Becker & Brainard Machine Co., *e*, $1,340. Prentiss Tool Co., *b*, $2,085; *d*, $3,100. American Tool Wks. Co., *d* (4 bids), $3,360 to $4,340. Baird Machine Co., *b*, $1,845. Kemp-Smith Mfg. Co., *e*, $2,500. Wm. Sellers Co., Philadelphia, Pa., *b*, $2,235; *f*, $1,865. D. S. Hayes, *b*, $1,920; *d*, $3,450. H. Buck Co., *d*, $4,080; *e*, $1,740. J. W. Creyier Agency, *d*, $3,530. Boyce Mfg. Co., *d*, $3,744; *e*, $1,390.

The following are the bids opened on Feb. 15 by the Isthmian Canal Comn., Washington, D. C., for furnishing stone crushers (delivery at factory): Power Mining Machinery Co., Chicago (Apr. 10), $10,000; Manning, Maxwell & Moore, New York (Apr. 3), complete $8,654, without engine $7,566; Motley, Green & Co., New York, N. Y. (May 3), $8,075; Austin Mfg. Co., Chicago, Ill. (2 weeks after contract), $9,490.

PROPOSALS OPEN.

For proposals see pages 20, 26, 27, 28 and 29.

Bids Close.	WATER WORKS.	See Eng. Record.
Feb. 20.	Specials, Washington, D. C. Adv. Feb. 4.	Feb. 4
Feb. 21.	Pumping engine, Chicago, Ill.	Feb. 18
Feb. 21.	Pipe, Boston, Mass.	Feb. 18
Feb. 22.	Schoharie, N. Y. Adv. Jan. 28, Feb. 4.	Jan. 28
Feb. 23.	Machinery, pipe, etc., Menasha, Wis., Adv. Feb. 11	Feb. 11
Feb. 23.	Mains, Ft. Preble, Me.	Feb. 4
Feb. 23.	Tilamook, Ore.	Jan. 14
Feb. 24.	Pipe, Milwaukee, Wis.	Feb. 18
Feb. 24.	Meters, Cleveland, O. Adv. Feb. 11, 18.	Feb. 11
Feb. 27.	Pipe, etc., Santa Ana, Cal.	Feb. 18
Feb. 28.	Waterman, Ill.	Feb. 18
Mar. 1.	Medina, N. Y., Adv. Feb. 18.	Feb. 18
Mar. 1.	Graham, N. C.	Feb. 11
Mar. 1.	Charton, Ia.	Jan. 28
Mar. 3.	Pipe, Youngstown, O.	Feb. 18
Mar. 3.	Hydrants, Youngstown, O.	Feb. 18
Mar. 3.	Valve boxes, Youngstown, O.	Feb. 18
Mar. 3.	Meters, Youngstown, O.	Feb. 18
Mar. 3.	Valves, Youngstown, O.	Feb. 18
Mar. 3	Tank, etc., Ft. Reno, Okla. Ter.	Feb. 11
Mar. 4.	Meeker, Colo., Adv. Feb. 18.	Feb. 4
Mar. 6.	Ford City, Pa. Adv. Feb. 11, 18.	Feb. 11
Mar. 6.	Pumping plant, Iowa Falls, Ia. Adv. Feb. 18.	Feb. 18
Mar. 8.	Mains, Ft. DuPont, Del. Adv. Feb. 11, 18.	Feb. 11
Mar. 8.	Filtration, Pittsburg, Pa. Adv. Jan. 28 to Feb. 18.	Jan. 28
Mar. 10.	Bishop, Cal.	Feb. 18
Mar. 11.	Basin, Lorain, O.	Feb. 18
Mar. 17.	Pipe and cstgs, Cincinnati O. Adv. Feb. 18.	Feb. 18
Mar. 21.	Well, Ft. Caswell, N. C. Adv. Feb. 4 to 18.	Feb. 4
Mar.31.	Meters, Pocatello, Idaho. Adv. Jan. 28 to Feb. 18.	Jan. 28
Mar. —.	Smith's Grove, Ky	Jan. 7
Apr. 1.	Irrig., Usk, Wash	Dec. 24
Apr. 10.	Main supply canal, Belle Fourche, S. D., Adv. Feb. 18.	Feb. 18
Apr. 10.	Pipe & Spcls, Winnipeg, Man. Adv. Feb. 18.	Feb. 18
Apr. 18.	New Orleans, La. Adv. Feb. 11, 18.	Feb. 11
Apr. 25.	Canal pipe, etc., N. Orleans, La. Adv. Feb. 18.	Feb. 18
May. 1.	Shirley, Ind.	Feb. 11
Apr. 4.	Alma, Neb.	Feb. 18
Apr. 4.	Goldendale, Wash	Feb. 11

SEWERAGE AND SEWAGE DISPOSAL.

Feb. 20.	Chillicothe, O.	Feb. 18
Feb. 21.	Middletown, O.	Feb. 18
Feb. 21.	Coldwater, Mich.	Feb. 11
Feb. 23.	New York, N. Y.	Feb. 11
Feb. 23.	New Rochelle, N. Y.	Jan. 28
Feb. 24.	Wilkesbarre, Pa. Adv. Feb. 4 to 18.	Feb. 4
Mar. 1.	Norristown, Pa.	Feb. 18
Mar. 1.	Brooklyn, N. Y.	Feb. 18
Mar. 1.	Brandon, Man., Adv. Feb. 18.	Feb. 18
Mar. 6.	Atlanta, Ga.	Feb. 18
Mar. 6.	Washington, D. C. Adv. Feb. 11.	Feb. 11
Mar. 10.	Bishop, Cal.	Feb. 18
Mar. 11.	Lorain, O.	Feb. 18
Apr. 18.	New Orleans, La. Adv. Feb. 11, 18.	Feb. 18

BRIDGES.

Feb. 20.	Culpepper, Va. Adv. Jan. 28.	Jan. 28
Feb. 28.	Superstructure, Selinsgrove, Pa.	Feb. 18
Feb. 21.	Celina, O.	Feb. 4
Feb. 21.	Kearney, Neb.	Feb. 4
Feb. 22.	Buffalo, N. Y.	Feb. 11
Feb. 23.	Dover, Ont.	Feb. 4
Feb. 28.	Minnedosa, Man.	Feb. 18
Mar. 1.	Tombstone, Ariz.	Feb. 18
Mar. 1.	South Bend, Ind.	Jan. 28
Mar. 4.	Valley City, N. D.	Feb. 11
Mar. 6.	Valparaiso, Ind.	Feb. 18
Mar. 6.	Amite City, La.	Feb. 11
Mar. 6.	San Jose, Cal.	Feb. 4
Mar. 13.	San Bernardino, Cal.	Feb. 11
Mar. 22.	Providence, R. I. (2 prop) Adv. Feb. 18.	Feb. 18

PAVING AND ROADMAKING.

Feb. 20.	Syracuse, N. Y.	Feb. 18
Feb. 21.	Promise City, Ia.	Feb. 18
Feb. 21.	Middletown, O.	Feb. 18
Feb. 21.	Winnipeg, Man. Adv. Feb. 4, 11.	Feb. 4
Feb. 21.	Cleveland, O.	Feb. 11
Feb. 21.	New York, N. Y.	Feb. 4
Feb. 23.	Peru, Ind.	Feb. 11
Feb. 23.	Geneva, N. Y. Adv. Feb. 11, 18.	Feb. 11
Feb. 23.	Brooklyn, N. Y.	Feb. 11
Feb. 23.	Cincinnati, O.	Feb. 4
Feb. 24.	Cincinnati, O.	Feb. 18
Feb. 24.	Columbus, O.	Feb. 18
Feb. 24.	Carlisle, Pa.	Feb. 11
Feb. 24.	Cincinnati, O.	Feb. 4
Feb. 24.	York, Pa.	Feb. 4
Feb. 25.	Celina, O.	Feb. 4
Feb. 27.	Detroit, Mich.	Feb. 18
Feb. 27.	Elyria, O.	Feb. 11
Feb. 27.	Wilkesbarre, Pa. Adv. Feb. 4 to 18.	Feb. 4
Feb. 27.	Hartford, Conn. Adv. Jan. 28, Feb. 4.	Jan. 28
Feb. 28.	Des Moines, Ia.	Feb. 18
Feb. 28.	New York, N. Y.	Feb. 18
Feb. 28.	Toledo, O.	Feb. 18
Mar. 1.	Indianapolis, Ind.	Feb. 18
Mar. 1.	Grass Valley, Cal.	Jan. 28
Mar. 3.	Cincinnati, O.	Feb. 11
Mar. 7.	Rockville, Ind.	Feb. 18
Mar. 7.	Broad Ripple, Ind.	Feb. 11
	[illegible]	Feb. 18
Mar. 16.	Bloomfield, Ind.	Feb. 18

POWER, GAS AND ELECTRICITY.

Feb. 20.	New York, N. Y.	Feb. 11
Feb. 21.	Washington, D. C.	Feb. 11
Feb. 21.	New York, N. Y.	Feb. 11
Feb. 23.	Governor's Island, N. Y.	Feb. 18
Feb. 24.	Rochester, N. Y.	Feb. 18
Feb. 27.	Los Angeles, Cal.	Feb. 11
Mar. 1.	Graham, N. C.	Feb. 11
Mar. 3.	Savannah, Ga.	Feb. 11
Mar. 10.	Stillman, Minn.	Feb. 18
Mar. 14.	Washington, D. C.	Feb. 18
Mar. 20.	Washington, D. C. Adv. Feb. 11.	Feb. 11
Mar. 21.	Norwalk, O.	Feb. 18
Apr. 11.	Shreveport, La.	Feb. 18
Apr. 12.	Lockport, Ill. Adv. Feb. 18.	Feb. 18
Apr. —.	Ft. Valley, Ga.	Jan. 21
May 1.	Shirley, Ind.	Feb. 11
———.	Branchville, S. C.	Feb. 18
———.	Laconia, N. H. Adv. Jan. 28.	Jan. 28

BUILDINGS.

Feb. 20.	Htg. school, Boston, Mass	Feb. 18
Feb. 20.	School, Long Island City, L. I., N. Y.	Feb. 11
Feb. 20.	Hospital, Albany, N. Y.	Feb. 4
Feb. 21.	Art Gallery, Toronto, Ont.	Feb. 18
Feb. 21.	Life Saving Sta., Sandy Hook, N. J. Adv. Feb. 11	Feb. 11
Feb. 21.	Municipal Court, New York, N. Y.	Feb. 11
Feb. 21.	Schools, Shamokin, Pa.	Feb. 11
Feb. 21.	Htg. Guard House, Ft. Assiniboine, Mont.	Jan. 28
Feb. 21.	Univ. Bldg., Washington, D.C.	Jan. 21
Feb. 21.	P. O. Bldg., Westchester, Pa. Adv. Dec. 31 to Jan. 7.	Dec. 31
Feb. 22.	Church, Peru, Ind.	Feb. 18
Feb. 23.	Sashes, etc., War College, Washington, D. C., Adv. Jan. 28 to Feb. 18	Jan. 21
Feb. 23.	Court House, Ellsworth, Wis.	Jan. 28
Feb. 23.	P. O. Bldg., Decatur, Ill. Adv. Jan. 14, 21.	Jan. 14
Feb. 24.	Pub. Bldg., New York, N. Y.	Feb. 18
Feb. 24.	School, Arthur, N. D.	Feb. 18
Feb. 24.	School, Toronto, Ont.	Feb. 18
Feb. 24.	School, Souris, N. D.	Feb. 11
Feb. 25.	Htg. P.O.Bldg., Anniston, Ala.	Feb. 4
Feb. 27.	Engine house, Cincinnati, O.	Feb. 18
Feb. 27.	School, New York, N. Y.	Feb. 18
Feb. 27.	School, Castleton, S. I., N.Y.	Feb. 18
Feb. 27.	School plans, Lowell, Mass.	Feb. 18
Feb. 27.	Post Bldg., Ft. Caswell, N.C. Adv. Feb. 4 to 18.	Feb. 4
Feb. 27.	Post Bldg., Ft. Morgan, Ala. Adv. Feb. 4 to 18.	Feb. 4
Feb. 27.	P. O. Bldg., Columbia, Mo.	Jan. 21
Feb. 28.	School, Storrs, Conn.	Feb. 18
Feb. 28.	Court House, Des Moines, Ia.	Feb. 18
Feb. 28.	Office Bldg., Pineridge, S. D.	Feb. 11
Feb. 28.	School, Two Rivers, Wis.	Feb. 4
Feb. 28.	P. O. Bldg., Louisiana, Mo.	Jan. 21
Feb. —.	Hospital, Albany, N. Y.	Dec. 24
Mar. 1.	Church, Shamokin, Pa.	Feb. 18
Mar. 1.	Orphanage, Jackson, Mich.	Feb. 18
Mar. 1.	School, Barrington, Ill.	Feb. 18
Mar. 1.	Church plans, Portsmouth, O.	Feb. 11
Mar. 1.	Court House, Lawrenceburg, Tenn.	Feb. 11
Mar. 1.	Htg. P. O. Bldg., Hastings, Neb., Adv. Feb. 4, 11	Feb. 4
Mar. 1.	School, Conway, S. C.	Feb. 11
Mar. 1.	Court House, Edna, Tex.	Feb. 4
Mar. 1.	Htg., etc., Post Bldg., Chickamauga Park, Ga.	Feb. 4
Mar. 2.	P. O. Bldg., Adrian, Mich.	Jan. 28
Mar. 3.	Pub. Bldg., Washington, D. C.	Feb. 11
Mar. 4.	School, Elkins Park, Pa.	Feb. 18
Mar. 4.	School, West Des Moines, Ia.	Feb. 11
Mar. 6.	Annex, I. O.O.F. bldg., Springfield, O.	Feb. 18
Mar. 6.	U. S. Soldiers' Home, Washington, D. C. Adv. Feb. 4 to 18.	Feb. 4
Mar. 6.	Church plans, Portsmouth, O. Adv. Feb. 18.	Feb. 18
Mar. 6.	Court House, Greenwood, Miss.	Jan. 28
Mar. 6.	P. O. Bldg., Battle Creek, Mich., Adv. Jan. 21, 28.	Jan. 21
Mar. 6.	Court House, Sardis, Miss.	Dec. 17
Mar. 7.	Court House, Hot Springs, Ark.	Feb. 18
Mar. 7.	P. O. Bldg., Findlay, O. Adv. Jan. 21, 28.	Jan. 21
Mar. 8.	Post Bldg., Ft. Baker, Cal.	Feb. 18
Mar. 8.	School, Niles, O.	Feb. 18
Mar. 8.	Hospital, Central Islip, N. Y. Adv. Feb. 18.	Feb. 18
Mar. 8.	Stone work for Pub. Bldg., Washington, D. C., Adv. Feb. 11, 18	Feb.
Mar. 8.	P. O. Bldg., Muskegon, Mich.	Jan.
Mar. 9.	School plans, Athens, Ga.	Feb.
Mar. 9.	Pub. Bldg., Little Rock, Ark.	Feb.
Mar. 9.	Sashes, blinds, etc., Panama	Feb.
Mar. 9.	School, Jicarilla, N. Mex.	Feb.
Mar. 9.	Post Bldg., Key West Barracks, Fla., Adv. Feb. 11, 18.	Feb.
Mar. 9.	Court House, Elbow Lake, Minn.	Feb.
Mar. 9.	Htg. U. S. Hospital, Savannah, Ga., Adv. Feb. 11, 18.	Feb.
Mar. 10.	Post Bldgs., Jefferson Barracks, Mo.	Feb.
Mar. 10.	School, Freeport, Ill.	Feb.
Mar. 10.	School Bldgs., Ft. Rodman, Mass., Adv. Feb. 11, 18	Feb.
Mar. 10.	Post Bldgs., Ft. Ontario, N. Y., Adv. Feb. 11, 18	Feb.
Mar. 11.	Police station, Newburg Heights, O.	Feb.
Mar. 11.	Naval Prison, New York, N. Y.	Feb.
Mar. 13.	School, Cleveland, O.	Feb.
Mar.13.	P. O. Bldg., Hammond, Ind. Adv. Jan. 28, Feb. 4.	Jan.
Mar. 14.	Remod. Jail, Grand Forks, N. D.	Feb.
Mar. 14.	School, Kearny, N. J.	Feb.
Mar.14.	P. O. Bldg., Moberly, Mo. Adv. Jan. 28, Feb. 4.	Jan.
Mar. 15.	Church, Clyde, Kan.	Feb.
Mar. 15.	Md. Insti. plans, Baltimore, Md.	Feb.
Mar. 15.	Univ. plans, Washington, D. C.	Feb.
Mar. 15.	Jail, Camden, N. J.	Feb.
Mar. 17.	Wagon shed, Ft. Caswell, N.C. Adv. Feb. 18.	Feb.
Mar. 20.	P. O. Bldg., Elizabeth City, N. C., Adv. Feb. 4, 11	Feb.
Mar. 21.	Armory, Rochester, N. Y. Adv. Feb. 18.	Feb.
Mar. 21.	P. O. Bldg., Laredo, Tex. Adv. Feb. 4.	Feb.
Mar. 23.	P. O. Bldg., Sherman, Tex. Adv. Feb. 4, 11.	Feb.
Mar. 27.	P. O. Bldg., Lebanon, Pa. Adv. Feb. 11, 18.	Feb.
Mar. 28.	P. O. Bldg, Superior, Wis.	Feb.
Mar.—.	School, Klamath Falls, Ore.	Jan.
Apr. 1.	Court House, Baraboo, Wis.	Feb.
Apr. 1.	Y. M. C. A. plans, Binghamton, N. Y.	Feb.
Apr. 5.	**Court House plans, New Orleans, La.**	**Dec.**
Apr. 15.	Court House, Grundy, Va.	Feb.
———.	School Bldg. material, etc., Phoenix, Ariz.	Feb.

MISCELLANEOUS.

Feb. 20.	Pipe, Philadelphia Pa.	Feb.
Feb. 20.	Board Walk, Avon-by-the-Sea, N. J.	Feb.
Feb. 20.	Garb. Disp., Waterbury, Conn.	Feb.
Feb. 21.	Pier, New York, N. Y.	Feb.
Feb. 21.	Brick, New London, Conn. Adv. Feb. 11, 18.	Feb.
Feb. 21.	Rip Rap stone, etc., New York, N. Y.	Feb.
Feb. 21.	Supplies, Washington, D. C.	Feb.
Feb. 21.	Dredging, Cleveland, O.	Feb.
Feb. 21.	Machine tools, Washington, D. C.	Jan.
Feb. 21.	Cement, Fernbank, O. Adv. Jan. 21 to Feb. 11.	Jan.
Feb. 23.	Garb. Disp., Darby, Pa.	Feb.
Feb. 23.	Dam, etc., Roosevelt, Ariz. Adv. Feb. 11, 18.	Feb.
Feb. 23.	Cement, etc., Newport, R. I. Adv. Jan. 28 to Feb. 18.	Jan.
Feb. 23.	El. Ry. franchise, San Diego, Cal.	Jan.
Feb. 24.	Cement, Minneapolis, Minn.	Feb.
Feb. 24.	Dump wagons, Troy, N. Y.	Feb.
Feb. 25.	Dredging, Philadelphia, Pa.	Feb.
Feb. 25.	Garb. Disp., New York, N. Y.	Feb.
Feb. 25.	Lock work, Cincinnati, O. (2 prop.) Adv. Jan 28 to Feb. 18	Jan.
Feb. 27.	El. Ry. franchise, San Jose, Cal.	Feb.
Feb. 27.	El. Ry. franchise, Stockton, Cal.	Jan.
Feb. 28.	Elevator, Omaha, Neb.	Feb.
Feb. 28.	Cars, Winnipeg, Man. Adv. Feb. 18.	Feb.
Feb. 28.	Contractors' Wagons, Panama	Feb.
Feb. 28.	Supplies, Washington, D. C.	Feb.
Feb. 28.	Rock Drills, Panama	Feb.
Feb. 28.	Machine tools, Washington, D. C.	Feb.
Mar. 1.	Garb. Disp., Cleveland, O.	Feb.
Mar. 1.	R. R. work, Charleston, W. Va.	Feb.
Mar. 1.	Cement, Brandon, Man. Adv. Feb. 18.	Feb.
Mar. 1.	Island. Ellis Island, N. Y. Adv. Feb. 4, 11.	Feb.
Mar. 2.	Iron, Brooklyn, N. Y.	Feb.
Mar. 3.	Cement, San Francisco, Cal. Adv. Feb. 11, 18.	Feb.
Mar. 6.	Dredging, Philadelphia, Pa.	Feb.
Mar. 6.	Rem. wrecks, Boston, Mass.	Feb.
Mar. 6.	R. R. tunnel, New York, N. Y.	Feb.
Mar. 6.	Drainage work, Nebraska City, Neb.	Jan.
Mar. 7.	Ditches, Storm Lake, Ia.	Feb.
Mar. 8.	Dredging plant, Detroit, Mich.	Feb.
Mar. 9.	Steel shed, N. Orleans, La. Adv. Feb. 18.	Feb.
Mar. 11.	Elevators, Portsmouth, N. H.	Feb.
Mar. 14.	Mach. tools, Washington, D. C.	Feb.
Mar. 14.	Cement, Wheeling, W. Va.	Feb.
Mar. 15.	El. Ry. work, Pittsfield, Mass.	Feb.
Mar. 15.	Cement, Peterborough, Ont.	Feb.
Mar. 15.	Dam, etc., Los Angeles, Cal. Adv. Jan. 21 to Feb. 18.	Jan.
Mar. 17.	Dredge, etc., St. Louis, Mo. Adv. Jan. 21 to Feb. 4.	Jan.
Mar. 18.	Cement, etc., Wilmington, N.C. Adv. Feb. 18.	Feb.
Mar. 20.	Ditch., Macon, Mo.	Feb.
Mar. 25.	Wharf, New Orleans, La.	Feb.
Mar. 31.	El. Ry., Shanghai, China	Oct.
———.	Hauling stone, Catskill, N. Y. Adv. Feb. 18.	Feb.
Apr. 10.	Channel work, Bermuda	Feb.
———.	El. Ry. franchise, Yazoo City, Miss.	Feb.

***Items marked thus give the names of parties awarded contracts.**